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Contents

Review of the Olean Flood in Relation to the Mutual Aid and Civilian Protection Programs. By Alan D. Drake and Frank O'B. Nehin 1743
Wartime Control of Water Quality. By Charles R. Cox 1755
The Value of Distribution System Studies for Meeting Present Emergencies and Post-War Problems. By E. Shaw Cole 1762
Preparing the Valve System for Emergency Service. By Alvin J. Kuecker 1767
Water Main Cleaning in the War Effort. By Clinton Inglee 1771
Sterilization of New and Repaired Mains. By C. H. Billings 1777
Control of Chlorination. Committee Progress Report 1782
Erratum 1784
A Modification of the Flash Color Test to Control Break-Point Chlorination. By Paul C. Laux and J. B. Nickel 1785
Discussion by C. K. Calvert 1786
Chlorine Residual and Bacteriological Quality. By Max Levine, Austin Heller and Richard Bender 1787
Maintenance of Chlorine Residual in the Distribution System:
Houston, Tex. By Clyde R. Harvill and J. H. Morgan 1797
Boonville, Mo. By Major C. Hagar 1801
Wheeling, W.Va. By Arthur R. Todd 1805
The Value of Sodium Hexametaphosphate in the Control of Difficulties Due to Corrosion in Water Systems. Committee Report 1807
Discussion by Frank E. Hale 1828
A Summary of Census Data on Water Treatment Plants in the United States. By S. R. Weibel 1831
Design and Operation Data on Large Rapid Sand Filtration Plants in the U.S. and Canada. By Eugene A. Hardin 1847
An Operator's Monthly Balance Sheet. By Charles E. Moore 1880
Manual on Emergency Repairs to Water Distribution Systems 1889
Emergency Alternate Provisions for Tentative Specifications for Cold Water Meters—Displacement Type—7M.1-T 1914
Revisions in Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs 1915
Priorities and the Controlled Materials Plan 1917
Tire Rationing Regulations 1924
National War Labor Board Letter 1925
Journal Circulation Statement for Month of September 1942 1926
The 1942 Conference 1927
Papers Scheduled at 1942 Section Meetings 1937
Index for Volume 34, 1942 1949
A.W.W.A. Publications—A List 2009
Coming Meetings vi
News of the Field 1
Changes in Membership 26
Changes in Address 30

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Review of the Olean Flood in Relation to the Mutual Aid and Civilian Protection Programs

By Alan D. Drake and Frank O'B. Nehin

UNPRECEDENTED rainfall created serious floods in southwestern New York and north-central Pennsylvania on the night of July 18, 1942. Crops were ruined, bridges destroyed, buildings demolished, power lines and communication systems put out of service, water mains broken, entire villages evacuated and nineteen lives were lost. The destruction was as devastating as if it were produced by a merciless enemy, but, although analogous in effect, the attacking force was not, of course, of military conception. The record-breaking torrential rains, however, caused the most destructive flood in the history of the particular section.

As the title would suggest, it is not the purpose of this paper, nor the intention of its authors, to delve deeply into the historical background or the meteorological or hydrological features of this flood. To those who, either by remoteness or short memory, are not familiar with the details of the storm or the flood locale, however, the following outline may be of assistance in visualizing the magnitude of the disaster.

The Allegheny River rises in a high plateau region in Potter County, Pa., at an elevation of 2,250 ft. above mean sea-level. The surface slope is very steep near the head waters, changing abruptly to a flat grade above Olean in New York State. In the first 30 mi., the river channel has a slope of 27 ft. per mi. The steep slopes of the numerous tributary streams

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A paper presented on October 15, 1942, at the New York Section Meeting, Albany, N.Y., by Alan D. Drake, Director of Water, and Frank O'B. Nehin, Pitometer Engr., Division of Water, Buffalo, N.Y.

and the high hills on both sides of the valley deliver runoff to the main water course so rapidly that comparatively short heavy storms are productive of excessive flood rates. The general topographical character of the region and the intensity of the rainfall combined to produce the type of disastrous flood that overwhelmed this area on the weekend of July 18, 1942. Then, the upper Allegheny River rose to unprecedented heights and four counties in Pennsylvania—Potter, McKean, Elk and Cameron—and parts of Allegany and Cattaraugus Counties in New York State suffered severely from submergence caused by the ensuing flood.

The rain, a series of cloudbursts, which began on July 17 at 11 P.M., was estimated by reliable observers, at the focal point on the watershed, to have exceeded 12 in. in a 15-hr. period. The official rainfall report accounts for 8 in. in 24 hr. at Olean and on over 700 sq.mi. of the upper Allegheny Basin. The average annual precipitation at Olean is 42 in. and the previous 24-hr. record, since 1917, was 2.5 in. As an indication of the localization of this storm, records show that at Jamestown, N.Y., about 40 mi. due west of Olean, only 1 in., and at Wellsville, N.Y., 25 mi. to the east, only 3.5 in. of rain fell. The U.S. Geological Survey Station at Red House, N.Y., 26 mi. below Olean, registered a record-breaking stage of 14.55 ft., with a discharge of 47,000 cfs. The previous maximum gage height at that point was 13.78 ft. with a discharge of 41,000 cfs.

Extent of Flood Damage

Throughout the flooded area, the damage to homes, railroads, highways, utilities, industrial and mercantile establishments and to farmers in loss of crops and livestock was extensive. More than twenty bridges, both railroad and highway, were washed out. There are, at the present writing, no comprehensive statistics showing the total loss directly attributable to the flood but the U.S. Geological Survey, in a preliminary estimate, placed the damage in both states at from ten to fifteen million dollars. The localized rainfall, the detaining action, by overflow, and the larger channel of the lower river spared Pittsburgh and the lower Allegheny Valley its almost annual inundation.

The authors are not unmindful of the distress and suffering endured by other cities and villages along the upper Allegheny River and its tributaries and are fully appreciative of the fact that the damage caused by the flood may have been greater, proportionately, in the smaller settlements than at Olean. Their attention is focused on Olean and its immediate vicinity because it is one of the larger affected communities where civilian protection and the Mutual Aid Plan have been given consideration and because they are more familiar with the difficulties encountered there.

Failure of Dikes

Olean, a city of 23,000, is located in southwestern New York State, on the Allegheny River, 55 mi. downstream from its source and at an elevation of 850 ft. below it. The river above Olean drains a watershed of approximately 1,200 sq.mi.

In 1918, Olean protected itself from inundation by the construction of dikes along the banks of the Allegheny River and the Olean Creek, a tributary meeting the river within the city. The dikes, standing 22 ft. high, had successfully met the challenge of all previous high water, but early in the morning of July 19, 1942, the heavy rainfall on the watershed above Olean brought a flood crest to the river that for the first time overflowed them. The final storm, with an accumulative effect, raised the river stage at Olean more than 22 ft. and, in spite of the valiant efforts and a futile 7-hr. battle of more than 5,000 workers, the river overflowed its artificial embankment. As the water broke over the dikes, by erosion, it created large channels that permitted enormous quantities of water to enter and inundate two-thirds of the city. To a community already partly flooded this brought additional grief and the most destructive flood in Olean's history. In the city and its environs, the water supply was menaced, electric power interrupted, telephone communication hampered and almost 3,000 homes flooded, half of them to the second floor.

Mobilization of Civilian Protection Forces

Realizing the danger that was imminent Mayor Walkerman D. Dugan and the office of the Director of Civilian Protection ordered all civilian protection forces on the alert sometime before the river had reached its final crest. The control center was put into operation and an immediate order called all air raid wardens and auxiliaries to duty. The emergency personnel was first assigned to the filling, transporting and placing of sand bags to reinforce the dikes at known critical points. This was an early and very important contribution as it, at least temporarily, retarded the flood and permitted the evacuation of many persons residing in the lower levels. The work of these public employees, auxiliaries and volunteers throughout the critical hours and days that followed is worthy of the highest commendation. Their duties, though arduous and often dangerous, were not made easier by the lack of sleep and nourishment. They assisted in controlling traffic, enforcing emergency regulations and performing police and guard duties. They manned the boats and formed rescue and evacuation squads. After the water had receded, theirs was the job of de-watering and decontaminating homes and of removing the flood debris.

Always outstanding was the spirit of civic loyalty, co-operation and devotion to duty. The contribution of the civilian protection program was apparent in the effect of training, organization, preparedness and pre-assignment of duty. It was the freely expressed opinion of many representative residents of Olean that these factors and the lack of confusion and panic undoubtedly contributed, in great measure, to decreasing the toll of lives, the destruction of property and to bringing order quickly out of the chaos and ruin engendered by the flood.

The local directors of Emergency Welfare Service co-operated with the American Red Cross, which, with its traditional promptness, provided centers on a mass basis for the registering, sheltering and feeding of evacuees. At the height of the emergency, a comforting note was the announcement from National Headquarters of the American Red Cross that all its resources were available for the rehabilitation of the individual families who were in need of assistance. Awards to victims in Pennsylvania, for the purposes of rehabilitation, will amount to more than $200,000 and similar payments in the New York State flood area will exceed $50,000. It is understood that in this instance, at least at Olean, the American Red Cross will incur all rehabilitation expenses and that no application is to be made, in respect to reimbursement, for the cost of emergency welfare services.

Assistance by Neighboring Communities

During the high water period of the flood a great number of small boats were required for the purposes of evacuation and rescue. Through the solicitation of local authorities and an appeal sent out to outside communities from Civilian Protection headquarters, more than 200 boats of all descriptions were received. In procuring and transporting these boats an inventoried list of trucks available locally that had been prepared previously by the Civilian Protection Office was of invaluable assistance. Later, this truck listing was also used to advantage in obtaining transportation for pumps and other equipment.

When the unwelcome waters had receded, Olean was faced with the herculean task of extricating itself from the consequences of the flood. A call for assistance was sent out from the Civilian Protection Control Center to all cities within a radius of 100 miles of Olean and they responded magnificently. Between 75 and 100 portable gasoline-engine-driven pumps, many fire department pumpers, street flushers, bulldozers and trucks were received. Perhaps more essential than the equipment was the expert personnel that accompanied it. At Olean, it was obvious that there was a real deficiency of men with the special skill, or subtle touch, required to keep a small gasoline engine in operation. Efficient mutual aid and

civilian protection planning perhaps requires the development, if necessary, and the classification and record of availability of such types of mechanics or small engine operators. Tinkering by incompetent but well-meaning auxiliaries is frequently serious in that it renders useless a much needed and sometimes irreplaceable piece of machinery. As an example of this, at Olean, $40,000 in equipment was subject to damage by incorrect operation, when an overzealous, but uninformed, volunteer took it upon himself to start a pump.

Health and First Aid Measures

Local and state health authorities promptly engaged in a preventive battle against unsanitary flood conditions. In Olean, four emergency immunization clinics were established, in which 17,000 persons, 75 per cent of the population, were inoculated against typhoid fever. The authorities widely publicized the doubt about the potability of the water supply and urged the consumers to boil all drinking water. As an indication of the thoroughness of these public health guardians, more than 800 private wells within a radius of 15 mi. of Olean received emergency chlorination treatment. Not one case of dysentery, typhoid or intestinal disturbance, traceable to the flood, has been reported. This commendable record is entirely due to the co-operative and untiring effort of the local, county and state health departments throughout the entire flooded area.

The Civilian Protection Emergency Medical Services set up casualty stations and administered first aid to over 200 persons suffering from minor injuries and shock.

The importance of having deputies in the key positions of all civil defense organizations was amply demonstrated at Olean when the occurrence of actual "incidents" found the Director of Civilian Protection, the Director of Emergency Medical Services and the Director of Food and Shelter all, unavoidably, out of the city when the flood broke. To the everlasting credit of an organization that was prepared to act, it can be stated that their replacements functioned perfectly and no impairment of efficiency was discernible at any time.

Operation of the Water Works

Olean derives its water supply from Olean Creek, a subsidiary of the Allegheny River. The treatment of the water begins with super-chlorination at the low lift pumps, then it is aerated to control the carbon dioxide content and pH value. The water passes through coagulation and sedimentation basins, twelve filters having a total capacity of 6.0 mgd. and finally is de-chlorinated using sulfur dioxide. There are two electrically driven high lift pumps with rated capacities of 3.0 mgd. and 1.5 mgd.,

which in parallel operation deliver approximately 4 mgd. Two distribution reservoirs, when full, provide a total of 10.0 mil.gal. storage. The average consumption is 2.4 mgd. The normal raw water has the following chemical characteristics: alkalinity, 66 ppm.; carbon dioxide, 5 ppm.; and pH, 7.0.

Throughout the flood, the filtration and pumping station, due to its location, was not seriously endangered. At noon Saturday, July 18, however, because the turbidity of the raw water had reached 2,000 ppm. and was increasing, the high lift pumps were shut down and the city supplied by the reservoirs. This was 15 hr. before the overflow of the dikes, but the heavy concentration of organic matter in the early runoff inhibited coagulation and made it impossible to prepare the water for filtration. At 7 P.M., that day, an attempt was made to resume operations at the filtration plant, but it was found that the turbidity of the water was still too high. Alum was added at the rate of 6.2 gpg. and a good "floc" obtained, but the extremely fine clay would not settle. At 3:30 A.M. July 19, the crest of the flood flow was reached. At 7 A.M., when the turbidity of the raw water had dropped to 300 ppm., the filtration plant was placed in operation and continued until stopped by power failure 4 hr. later. At 5 P.M., the local power company supplied sufficient emergency power, obtained from a local industrial plant, to permit the starting of the 1.5-mgd. pump. There were, then, 16 ft. of water in the reservoirs, giving adequate pressure throughout the system. The normal pre-chlorination dosage is 3.5 ppm. At this time, the chlorine demand was 15 ppm. and, after de-chlorination, water containing approximately 1.0 ppm. was supplied to the system.

Water System Emergencies

At 8:20 A.M. on July 20, while the flood water receded, the pump discharge pressure suddenly dropped from the normal of 105 to 20 psi., indicating a serious main break. The pump was throttled and continued in operation. At 11:30 P.M., additional power was made available and the 3.0 mgd. pump was substituted for the 1.5-mgd. unit. The discharge pressure was still some 75 psi. below normal. On July 21, 29 hr. after it occurred, the break was isolated by valving off an extensive area, such action being necessitated by high water. The remainder of the city then received its normal pressure.

By this time the turbidity of the raw water had dropped to 150 ppm., the total alkalinity was 66 ppm., the pH, 7.0 and the carbon dioxide content, 5 ppm. Because of the difficulty encountered in coagulating the very fine clay in the raw water, the alum dosage was raised to 9.0 gpg.

Lime was added at the rate of 4 gpg. to increase the pH, which had been reduced to 6.4 by the heavy alum dosage.

Further investigation proved that there were two broken mains—parallel 12-in. submerged pipes at an Allegheny River crossing. These pipes connect the reservoirs to the distribution system, but a remaining 18-in. main has sufficient capacity to carry the normal load. There were no serious fires while the city was inconvenienced by low water pressure and 8.0 mil.gal. were retained in the reservoirs as an emergency supply. In the city, there was no dearth of a water supply for fire pumps, as almost every cellar presented its own fire reservoir.

On July 22 with the flood crisis clearly over, the maximum demand was made on the pumping equipment when "cleaning-up" operations began. Although pumping was continued throughout the night at the rate of 4.0 mgd. it was found impossible to gain head at the reservoirs. Storage was being depleted and a definite fire hazard created; consequently, the following notice was prominently displayed in a local newspaper on July 23:

SPECIAL NOTICE TO WATER CONSUMERS

WHEREAS the volume of water being used by consumers to clean up their homes in the City of Olean far exceeds the maximum capacity of the Olean Water Filtration Plant, and,

WHEREAS the reservoirs are steadily losing water as a result of this extraordinary demand, and,

WHEREAS it is necessary to conserve water for fire protection purposes,

THEREFORE, in view of the police power invested in the Mayor and Common Council providing for emergency power for the public health and safety of the City of Olean, a state of public emergency exists with respect to the volume of water available for fire protection purposes. And, in order to conserve water for such fire protection, the use of water hose for cleaning-up purposes is hereby limited to the hours of 9 to 12 A.M. each day until further notice.

Any person or corporation violating this emergency ordinance will be prosecuted for misdemeanor. The Police Department and all deputies of the Police Department are hereby charged with the enforcement of this rule and are directed to make arrests on the basis of a warrant.

(signed)
WALKERMAN D. DUGAN
Mayor

This had the desired effect, in restoring the demand to a rate of approximately 3.0 mgd.

Protection of Water Quality

There was a serious threat of water supply contamination when a main break reduced the pressure to 20 psi. at the pumping station and possibly below atmospheric pressure at certain points of the distribution system. Probably many faucets remained open in hastily abandoned cellars, flooded with polluted water. Cellar sump pumps were also a menace.

Risking complaints of chlorinous taste in the interest of security, de-chlorination of the effluent was discontinued and water was pumped into the distribution system with a chlorine content of from 1.0 to 2.0 ppm. It was found that the public, realizing the importance of this health safeguard and the protective value of a water supply, was willing to tolerate a temporary unpleasant taste.

The county health authorities took numerous samples throughout the system and found residual chlorine of not less than 0.15 ppm. in every sample, with no evidence of the presence of any organisms of the coliform group. Purely as a precautionary measure, the consumers were urged and instructed, through the radio and the press, to boil all water to insure its potability. After normal pressure in the distribution system was restored and the samples indicated that there was no contamination, the water boiling restrictions were removed. De-chlorination was then resumed and the chlorine content of the filtration plant effluent was reduced to 0.3 ppm.

Mutual Aid Assistance

From the foregoing description it can be seen that, while the city battled the intruding floods, the water department underwent three critical periods. First of these emergencies was due to a serious electric power supply failure, which could have been nullified if the proposed installation of auxiliary diesel engines had been carried out. The second was the period of low pressure induced by a major main break, the seriousness of which was greatly increased by an incorrect valve location. And last of the critical periods was the overtaxing of the system by an unexpected and excessive demand, remedied in the only way possible, by requiring a more reasonable leveling-off of the consumption.

The assistance rendered to Olean by outside communities in the matter of forwarding pumps, trucks and other equipment reflects the spirit and the meaning of the Mutual Aid Plan, but some points of the program, applicable to water works, were put to the test and are worthy of further discussion.

The Olean Water Department carried on through the most difficult period of the flood with little need for outside assistance. It was not until the pressure of the system was materially reduced by a main break

that it was involved in any serious difficulties. At that time (July 20 at 11 P.M.), the extent of the damage to the distribution system being unknown, the Olean Office of Civilian Protection contacted the Mutual Aid Co-ordinator for Zone 9, at Buffalo, and, through him, the full facilities of the Buffalo Department of Public Works were offered to Olean by Mayor Joseph J. Kelly and Commissioner of Public Works Newell L. Nussbaumer. As requested, the pipe locating and leak detecting equipment, with operating personnel, were dispatched to Olean with orders to stand by and to prepare to render whatever assistance was necessary.

Inadequacy of Valve Location System

The valve location system of the Olean Water Department apparently left nothing to be desired. The records were clear, complete, and, it was hoped, accurate. According to the map, five 12-in. valves would isolate the main break when its location was finally determined; but, unfortunately, an error had inserted itself into the measurements made in locating one of the valves. Due to this incorrect information, it was impossible to locate the valve, and, in substitution, it was necessary to operate 38 additional valves. What should have been a matter of minutes, in valving off the break, became a matter of hours. It must be remembered that this was valve operation under extreme flood conditions. At least half the valves were under very dirty waters, many of them being covered to depths of 3 ft. Overlooking the very important time element, the many other consequences of increasing the valved-off area are readily apparent to all water works men. The moral is clear—valve locations should not be accepted until the measurements have been checked, "the valve box being exposed" and everyone in the water department knowing "just where that valve is" notwithstanding.

Future Plans for Mutual Aid Procedure

The experience at Olean seems to indicate that the Mutual Aid Plan might be improved by the application of some thought to the matter in which incoming equipment is received, dispatched and handled. A program for handling the equipment could take the form of intelligent planning for the establishment of receiving depots and the inclusion of local liaison officials and assistants charged with the responsibility of receiving, allotting and recording the location of all equipment received from other communities, as well as the very important duty of guaranteeing the return of the equipment in an unimpaired condition. This would have a tendency to reduce the confusion usually attendant upon the occurrence of sudden and unexpected emergencies or incidents, would result in the general speeding up of the arrival of the equipment at its

ultimate destination and would demonstrate a solicitude for the property of the communities who have come to the aid of the stricken one.

As a secondary consideration in this respect, perhaps could be found the solution of the problem of housing and feeding borrowed personnel, so that relief or welfare agencies would not have to be depended upon for this important service.

Proper Use of Personnel Insignia

It is the generally accepted and correct impression that identifying insignia, such as armbands, are worn for the purpose of expediting the activities of the authorized wearer and of permitting his unhampered movement, in performing his duties, within restricted areas. They also serve, in the excitement and turmoil of a sudden emergency, as a means of quickly distinguishing between serious auxiliaries or qualified volunteers and meddlers, sightseers or the overcurious. If the area involved in the incident is extensive or if the demand for assistance is urgent there may be an inclination to relax the strict regulations governing the issuance and wearing of such insignia. To the observer at Olean, it was obvious that such a widespread disaster could be readily utilized as a fertile field for the insidious activities of intriguers, saboteurs and other subversive elements. The armband or insignia and the guard system are a combination intended to defeat such treacherous purposes, so that each element of that combination requires as much thought and investigation as the other. The importance and seriousness of retaining, and not indiscriminately transferring, insignia should be firmly impressed on all auxiliaries.

Other Emergency Measures

In reference to the operation of the emergency water delivery service, the authors quote directly from the report of C. J. Bernhardt, District Sanitary Engineer of the State Department of Health:

"On Monday morning (July 20) following the failure of the water system, I outlined a program for emergency water delivery service in Olean. However, water was available at the filtration plant and trucks were dispatched there to obtain city water in milk cans. These were transported to the four Red Cross emergency centers where homeless people were fed. Mr. Fuller stated that over one thousand persons came to the filtration plant with bottles and other household containers to take home sufficient water for potable purposes. About 50,000 gallons of water were taken in milk cans from the filtration plant to the emergency Red Cross centers. All milk cans were disinfected with HTH before each filling."

The Olean sewage treatment plant and pumping stations were kept dry through the sandbagging efforts of public employees, volunteers and auxiliaries. Had it not been for the power failure, the sewage pumps would have remained in service through the flood period. This would have had the effect of decreasing the head in the sewers and eliminating some of the cellar flooding. Throughout the period an 85-hp. diesel engine, driving a 5,000-gpm. pump was used to by-pass the plant and to lift the discharge from the sewers directly into the river. In this work, there was an example of the benefits of the Mutual Aid Plan, borrowed electric-motor experts assisting in drying out the pump motors and in preparing the stations for operation before the power was fully restored.

Conditions in Portville, N. Y., a village of about 1,000 people, six miles above Olean, are offered as an example of the applicability of many features of the Mutual Aid Plan to a small community. The flood waters there reached a height of over 10 ft., causing the evacuation of practically all the residents. The incident demands of flushing, cleaning and a broken submerged water main overtaxed the regular water supply. Fortunately there existed a new and auxiliary supply which was drafted into service to meet the increased demand. In isolating the main break, under difficult conditions, the operators of the system learned that their lack of valve location records and their incorrect maps might well result in greater disaster. They freely expressed the opinion that it took a catastrophe to bring the lesson home. They, too, could have found use for an emergency water delivery service, had such a system been previously developed.

Conclusions

Those to whom, at present in comparative tranquility, is entrusted the unfailing operation of a water supply system will find the preparative and precautionary measures necessary to meet almost any emergency, including a flood, generally embodied in the Mutual Aid Plan. Such officials should familiarize themselves with its aims and objectives. They should put its recommendations into practice, remembering its benefits are reciprocal. They must learn that it is important to prepare for eventualities—to prepare *now*, that procrastination has no part in the program.

The following conclusions refer directly to the Mutual Aid Plan:

1. To reduce loss and confusion in reclaiming it, all material and equipment available for transmission to other localities should be clearly painted or stamped with identifying markings, *now*.

2. In making a choice of equipment to ship, it should be remembered that portability is an important characteristic. The handling of heavy and cumbersome equipment may be the source of delay and may entail a waste of manpower.

3. Other media than the radio should be available for disseminating such emergency notices as "boil water." The power may be off, putting practically all receivers out of service.

4. The overloading of the telephone system should be considered. During the four-day peak of the emergency, the local calls in Olean increased 184 per cent and toll calls increased 150 per cent. Calls to and from the Control Center were treated preferentially.

5. The place for the water superintendent during an emergency is in the field, not at the Control Center. It is essential, however, that the water department be capably represented in the Control Center.

6. All key positions should be three-deep with replacements. A 24-hr. day is too lengthy for efficient service, even in emergencies.

To reduce the flood menace in the upper Allegheny Valley, local, state and Federal committees are, at present, accumulating data and preparing plans for flood-remedial and protective measures. These include the deepening and re-coursing of the streams, the reinforcement and rebuilding of dikes, the construction of flood control dams and detention basins. It is hoped that the inhabitants of this area will never again find it necessary to combat the almost irresistable energy of the rampaging river, but if the flood should come they plan to prepare to meet it.

The authors wish to express their gratitude to Walkerman D. Dugan, Mayor of Olean; B. M. Marcus, Olean Director of Civilian Protection; Nelson M. Fuller, Superintendent of the Olean Water Department; and C. J. Bernhardt, District Sanitary Engineer, New York State Department of Health, all of whom furnished data for and co-operated in the preparation of this paper.

Wartime Control of Water Quality

By Charles R. Cox

PRACTICALLY all aspects of water works management and control at this time either present new problems for which there is little precedent or involve the intensification of old problems, the solution of which is difficult because of the critical shortage of materials and labor or because of their aggravation by existing emergency conditions. Notwithstanding these handicaps, it has been clearly demonstrated in England that energetic application of well considered plans for the protection of the quality of potable public water supplies has resulted in the maintenance of a satisfactory record in regard to water-borne diseases. This, of course, has necessitated drastic action, especially in the emergency disinfection of repaired distribution systems.

The delivery of water of safe sanitary quality cannot be considered merely in the light of treatment and laboratory control, but should be related to the general problems of protecting and supervising water supply systems. It is pertinent, too, to emphasize certain practical factors which may be overlooked in considering the general aspects of the subject.

There seems to be a tendency to place greater and greater emphasis upon purification as a means of insuring high standards of water quality. Over 50 per cent of the public water supplies in New York State, however, are not treated in any way; thus, the maintenance of their quality depends solely upon the protection afforded the sources of supply and the distribution systems. This situation becomes of practical significance in the consideration of emergency chlorination, because, obviously, it is much more difficult to arrange in untreated supplies. On the other hand, were damage by bombing to occur, the subsequent necessity of disinfecting repaired mains would necessarily not be restricted to treated supplies.

Wartime problems should not divert the attention of water works men from their regular duties of enforcing rules and regulations protecting

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specific supplies nor from their routine supervision designed to reduce insofar as possible the degree of pollution of raw waters. Intensification of routine duties in this connection will greatly assist in minimizing the chances for willful contamination of water supplies as well as the chances of unforeseen and marked increases in the pollution of waters to a degree beyond the capacity of available treatment processes.

The necessity for special care in the protection of water stored in equalizing reservoirs, which will be delivered to the public without subsequent treatment, is obvious. The critical shortage of materials in many cases makes impossible structural changes which are both logical and sound from an engineering standpoint, so recourse must be had to fencing, patroling, illumination, etc. The effectiveness of such protection should be demonstrated by routine examination of samples of water collected at significant points.

Modification of Conventional Treatment Procedures

Coagulation

The clarification of water by coagulation may become such a routine process that the accompanying removal of bacteria is overlooked. There is ample evidence, however, that the degree of bacterial removal can be materially improved by application of coagulant doses above those merely required for clarification purposes. Furthermore, soluble organic matter is removed more effectively, thus making subsequent chlorination of the water more uniform and certain. Plans should, therefore, be made to intensify the coagulation processes during periods of emergency, when the raw water may be subject to an unforeseen and rapid increase in the degree of pollution or when emergency conditions present new problems justifying extra precautions. Bombing and the introduction of chemical warfare agents into reservoirs are two such new sources of danger.

Activated Carbon Treatment

Many filtration plants are equipped for the application of activated carbon to the water for taste and odor control. There again consideration should be given to adapting this treatment procedure to emergency conditions, so that the carbon may be used to the fullest extent possible to absorb deleterious materials which may be present in raw waters during periods of emergency.

Rates of Filtration

Everyone is so familiar with the conventional rate of filtration of 125 mil.gal. per acre per day that the value has been given a status of finality. Such a viewpoint, however, overlooks a definite relationship between the

effectiveness of filtration and the rate of filtration, other things being equal, especially when pre-treatment may be faulty during emergencies or when the plant is seriously overloaded because of the unforeseen and unusual increase in the degree of pollution of the raw water. Definite arrangements should be made, therefore, to insure the maximum effectiveness of filtration by lowering the unit rate of filtration during periods of emergency to a rate consistent with the delivery of the required volume of water. It follows, therefore, that the volume of water filtered should not be reduced by shutting down individual filters but rather by decreasing the rate through all of the available filters.

Chlorination

Current literature includes innumerable papers dealing with the emergency chlorination of water supplies during the war period. There is a great difference, however, between the general consideration of emergency chlorination procedures and their application in light of the multiplicity of local conditions surrounding any given supply. Successful application, therefore, requires a detailed consideration of such local conditions and the development of appropriate plans for utilizing available equipment.

The capacity of existing chlorinators frequently is inadequate to permit the marked increase in chlorine doses required during periods of emergency. In many instances, minor changes will permit an increase in chlorinator capacity, but in others the shortage of critical materials will hamper improvements. Nevertheless, chlorinator capacity should be considered both in the light of anticipated increase in the chlorine demand of the raw water as well as the added doses which might be used during periods of emergency to maintain residual chlorine throughout the distribution systems during an actual air raid. Practical difficulties in this connection will be discussed later.

Effectiveness of Chlorination

The familiarity with chlorination and the routine control of this treatment process through the use of the ortho-tolidine test unfortunately have encouraged undue confidence in the effectiveness of moderate concentrations of residual chlorine for the disinfection of water, without giving due consideration to the factors which control the effectiveness of the chlorine. Everyone confronted with the control of chlorination during the war period, therefore, should determine just what concentrations of residual chlorine should be maintained in the light of local water characteristics, available detention periods, etc. This requires the correlation of the results of the bacteriological examination of samples of chlorinated water with the results of the ortho-tolidine test. Fortunately, the deleterious

influences of low temperatures, high pH values, high concentrations of organic matter and ammonia may be appraised in a practical manner through the use of a simple modification of the ortho-tolidine test known as the "flash test," as developed by Laux* several years ago in connection with studies of super-chlorination at Anderson, Ind.

Without going into technical details, it is pertinent to emphasize that the rapidity of the development of color when residual chlorine reacts with the ortho-tolidine reagent is an approximate measure of the activity of the chlorine as a disinfectant for the specific water under consideration. Generally speaking, it has been found that active chlorine of high disinfecting properties is present in water when the color produced with the ortho-tolidine reagent after a 15-sec. reaction period is over 80 per cent of that developing after the conventional 5-min. reaction period.

The significance of the values so secured may be illustrated by considering the chloramination, i.e., the chlorine-ammonia treatment, of water. The "flash test," for instance, will clearly demonstrate that the more stable chloramines resulting from the application of both chlorine and ammonia to waters may be deceiving because the stability of the residual chlorine has been secured at the expense of the disinfecting activity, i.e., the rate of disinfection. This may be compensated for in individual instances by the availability of long disinfecting periods before the chlorinated water is delivered to the first consumer. In other instances, however, the chloramination will be shown to be unreliable because of deleterious influences of high pH value, high organic content, etc., so that modification in treatment is justified. This may take the form of reducing the ratio of ammonia to chlorine well below the conventional ratio of one to three used in general practice. In fact the trend is to use lower ammonia ratios except when tastes and odors are being controlled. In other instances, chloramination should not be practiced.

This apparently complicated situation becomes less academic and more clear when the treatment of specific water supplies is investigated. Such investigations are needed during the war emergency to disclose the actual activity of the stable chloramines which may have been maintained heretofore in distribution systems. Otherwise, it may erroneously be assumed that the apparently high concentration of residual chlorine will effectively destroy temporary bacterial pollution introduced into distribution systems through inter-connections and cross-connections during periods of emergency, when water pressures may be low or negative. Obviously, very rapid disinfection is needed under these conditions to insure the destruction of the bacterial pollution before the water is delivered to consumers on properties in the vicinity of the point of pollution.

* LAUX, P. C. Break-Point Chlorination at Anderson, Ind. Jour. A.W.W.A., **32:** 1027 (1940).

It seems evident that chloramines do not provide sufficiently rapid disinfecting action, even assuming that the concentration of residual chloramines exceeds the chlorine demand incidental to the pollution of the water. This pessimistic note is not intended to undermine faith in chlorination, but merely to encourage a realistic approach to the problems involved.

It may be asked then, what can be done to compensate for the deleterious influences of factors mentioned above, thereby to secure the presence, in the treated water, of a stable residual chlorine which is highly active as a disinfectant in contrast to chloramines. The answer is the application of super-chlorination when feasible under local conditions. The difficulty, however, is that the critical shortage of chlorine and chlorine compounds, together with inability of securing supplies needed to increase materially the capacity of available chlorination equipment, places a practical limitation upon the extent to which super-chlorination can be adopted. Again this is not being stated in a pessimistic tone but merely to encourage frank appraisal of the problems involved.

Unless these problems are faced and appropriate plans are made to adopt super-chlorination when feasible under local conditions, one may be deluded into concluding that during periods of actual bombing one need merely increase the dose of chlorine and secure the benefits of super-chlorination. These benefits, however, cannot be secured unless the treatment is practiced for a sufficient period of time to oxidize the organic film which coats the distribution system; in other words the chlorine demand of the material must be satisfied. Also, unless the dose of chlorine is sufficiently high to result in the oxidation of the organic matter in the raw water so that the desired highly active residual chlorine is secured, the benefits cannot be obtained.

Therefore, laboratory experiments should be conducted by those in position to adopt super-chlorination, so that specific information, on which they can draw their plans, may be secured regarding the characteristics of their supply. If local conditions do not permit the practice of super-chorination, then plans should be made to modify conventional chlorination insofar as possible to insure the presence of appreciable concentrations of "active" residual chlorine, as indicated by the results of the "flash test." This compromise will improve disinfection but will not secure the freedom from taste difficulties associated with true super-chlorination.

Emergency Disinfection of Water Mains

A great deal has been written recently regarding the emergency disinfection of mains following repairs, especially under conditions where bombing would disrupt both mains and adjacent sewers and where gross pollution would occur. While stress has been placed on the necessity of flushing

mains to remove debris, sewage and other foreign materials, to insure effective disinfection, there is definite evidence that even greater attention must be given to the preliminary cleansing process to insure prompt and effective disinfection, even when chlorine doses of 50 to 200 ppm. are used. It is evident, for instance, that a high dose of chlorine may result in the superficial disinfection of the surface of polluting material, but permit the bacterial pollution to remain after the heavily chlorinated water has been flushed from the main.

Every effort should be made to prevent the entrance of polluting material into mains insofar as this is possible, and special attention should be given to the thorough flushing of mains before the disinfecting process is started. This, of course, is difficult when damage is incidental to bombing and when the disinfection process must consist of the application of the dry hypochlorite powders in the mains while they are being repaired, thus preventing preliminary flushing. It is obvious, therefore, that this treatment procedure should not be used except when absolutely necessary, but that stress should be placed upon the use of portable chlorinators or the forcing of chlorine solutions into the mains by using small hand-operated force pumps following the flushing operation.

Laboratory Control of Water Purification Processes

The peculiar problems growing out of the war necessitate a review of laboratory control from the standpoint of sampling procedure and the types of analytical procedures to be followed, all with due consideration of the most appropriate use of available technical personnel and equipment. It is pertinent, therefore, to examine the actual value of specific analytical procedures during the war emergency, with the general thought of simplifying the work insofar as possible, so as to permit a desirable increase in the number of samples examined. In view of the minuteness in volume of samples, compared with the volume delivered to consumers, it is doubtful that too many samples are collected. Sampling frequency should be increased and sampling points so modified that concrete administrative significance can be assigned to the results in terms of control of water supply quality during the emergency.

Although there is no single simple test of the potability of water from the standpoint of chemical quality, routine analytical procedures following present practice are of importance in disclosing the general characteristics of any given supply, because they disclose fluctuations in quality. For instance, the determinations of pH, alkalinity, chloride content, chlorine demand and oxygen consumed values may not in themselves be specific for deleterious substances in water, but, on the other hand, any marked changes in these values should be a signal for an investigation. The im-

portant point is that these tests must be made as a routine and sufficiently frequently to create a general picture of the characteristics of any given supply, so that these may accurately serve as guides to the supervision of the supply.

Less significance is now attached to the value of the 37°C. agar count in determining sanitary quality of potable water, because chief stress is being placed upon the test for coliform organisms. It should not be overlooked, however, that even though the concentration of miscellaneous bacteria in a water supply may lack quantitative sanitary significance, fluctuations in the number of such miscellaneous organisms may disclose changes in quality of significance during periods of emergency. In this respect, again, it is essential for these values to be appraised properly in the light of normal conditions surrounding the supply, so that abnormality will be disclosed with certainty.

Much of the above discussion may appear to be pessimistic in tone. It is evident, however, that a realistic approach to the problems involved is the only way in which adequate action may be insured; and action in accordance with appropriate plans underlies the delivery of water of safe sanitary quality.

The control of water supply quality cannot be relegated to the realm of the laboratory and the water purification plant, but must be considered as an important adjunct of the more general plans of so maintaining and operating water supplies that, in spite of the critical problems involved, adequate precautions may be taken to insure the actual delivery of a water of safe sanitary quality. In spite of such precautions there may be times when uncertainty exists as to the actual bacterial quality of the water in distribution systems. Under these circumstances local health departments should issue a general "boil water" warning, and, if necessary, potable water should be made available to the general public through the use of properly organized auxiliaries transporting water in portable containers in accordance with a planned organization. In other instances, valves should be closed to isolate in reservoirs waters suspected to be of unsafe quality until the emergency is over and appropriate tests can be made as to the actual quality of the water.

The watchword should be preparedness and the energetic execution of plans to meet emergencies. There is ample opportunity for the exercise of imagination, ingenuity and "guts" in this important work.

The Value of Distribution System Studies for Meeting Present Emergencies and Post-War Problems

By E. Shaw Cole

OF THE many problems the war has presented to the water works industry there are two which the Pitometer Company's engineers have been proud to help solve. First of these is the problem of conservation of water through water waste surveys to avert serious shortages in many cities. The other, which is the subject of this discussion, is the problem of provision for the adequate distribution of water to meet the increasing demands of war industries and housing developments, in addition to the normal domestic and industrial demands.

Unfortunately the migration of industry, as well as population, toward the more desirable locations in the outskirts of cities has been greatly accelerated in the last few years by the Federal Housing Administration, the defense and lease-lend boom, and finally the war boom. In Greensboro, Salisbury and Charlotte, N.C., where distribution system studies have recently been completed, the growth in the outskirts created demands that were increasingly difficult to solve. Almost overnight, large war plants have sprung up at great distances from the center of some cities and their demands for water have in many cases imposed a serious, if not disastrous, load throughout the entire length of a distribution system. In Charlotte, for example, just as the report of the study was completed, the engineers who had made it were advised that a proposed war plant requiring 1.0 mgd. from the city was to be built six miles from the end of the city mains.

Most cities have been able to satisfy the gradually increasing demands in the outskirts of their systems, either with the existing facilities or by making a few extensions; but as industrial activity has increased, many have found major improvements necessary, because of continually poor pressures due to a drop in the hydraulic grade line all the way from the pumping station to the far end of the system.

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Fortunately, there was adequate rainfall throughout the country last summer practically to eliminate the usually heavy lawn-sprinkling demands, so that they were not added to the already large loads. If next summer is dry or even normal, however, there will be many difficult periods of low pressure which it is hoped will not seriously curtail the service to war plants.

Ordinarily, if funds were available, the permanent solution of the problems imposed by the new loads would be easy to solve by the construction of properly designed reinforcing mains, tanks, reservoirs or booster stations. Today, however, these problems must be solved, for the most part, by resorting to the "Save, Stretch and Share" program recommended in a recent issue of the JOURNAL.* In a few cases it has been possible to obtain high priorities for the purchase of pipe for the supply of war plants. Under either of these conditions a distribution system study is valuable in solving the present difficulties and also in providing a comprehensive plan for post-war public works projects.

Outline of the Pitometer Distribution Study

The Pitometer distribution study is a study of the requirements of a distribution system based on definite information obtained from field tests as to the use and need of water, and the ability of the existing system to satisfy the present and future requirements. The future water requirements are estimated by co-ordinating population studies with the water now supplied to the system as a whole, and to its various sections. The present water consumption in the various sections of the city is determined from Pitometer measurements and the probable future population, fifteen or twenty-five years in the future, from analyses of the past growth and the opportunities for a continuation of the same trend.

The actual physical condition of the distribution system is determined by various field tests that are usually made in conjunction with Pitometer flow gagings. These include loss-of-head tests, hydrant-flow tests and a pressure survey. All results are thoroughly analyzed; and are made available for use as a basis for the design of the extensions and reinforcements and for checking hydraulic computations.

Loss-of-Head Tests

As a preliminary to the loss-of-head tests, a 24-hr. gaging of the flow is made under normal operating conditions, with the Pitometer, on the section of main to be tested and at critical points, to determine how the various feed mains operate. Then the test is made by closing all side valves along the section and measuring the flow and loss of head simultane-

* A.W.W.A. Objectives—1942. Jour. A.W.W.A., **34**: 1295 (1942).

ously. From these measurements the present internal condition, carrying capacity and friction coefficient are determined. This information is extremely important, not only because it gives an accurate friction coefficient for design purposes, but also because economical improvements can often be made by cleaning important mains or by otherwise removing obstructions or bottlenecks. In Salisbury, N.C., for example, a low coefficient on a 10-in. main was later found to be caused by a short section of 4-in. main that created a bottleneck, which reduced the Williams-Hazen coefficient, C, to 41.

In one New York State city, the principal feed main for the system was found to have the very low coefficient of 39. Investigation showed that a broken 20-in. valve was partially closed, so that after the gates had been removed, a retest gave a coefficient of 86. The size of mains needed to reinforce the system was accordingly reduced with definite assurance of adequate support.

In a large midwestern city, plans had been made for a large reinforcing main to feed an industrial area in the outskirts, to the west of the pump station. Later, Pitometer gagings showed that a large amount of water for the mercantile section, north of the pumping station, reached that area by going first to the west and then back to the north by a round-about route. The obvious remedy for this condition was a feed main directly to the principal mercantile area. This was not only a shorter and cheaper main than originally planned, but, most important, it solved the problem, which the other main could not have done.

Another advantage of the loss-of-head tests, particularly at this time, is that cleaning is one of the few improvements that can be made without priorities or the construction of new mains. Accurate information regarding the condition of the mains will justify the need for cleaning and provide a logical basis for a cleaning program.

Hydrant Flow and Pressure Tests

Hydrant-flow tests made at frequent intervals show the amount of water available for fire fighting purposes and also provide a splendid check on the operation of the system. Occasionally, computations of the strength of the grid do not agree with hydrant-flow tests, a condition which usually leads to the discovery of some obstruction not located by the loss-of-head tests. In addition, weak spots are definitely located and provisions made for suitable reinforcements.

The pressure survey includes sight readings at frequent intervals; and, under certain conditions, continuous records are made to obtain information regarding changes in the hydraulic grade line. As with the other tests this information provides a sound basis for design.

At Charlotte, N.C., certain fixed conditions—the pumping head and the overflow elevation of three tanks—controlled the operation of the distribution system. Normally these tanks floated on the system, emptying during peak demands and filling at night. Recently, because there had been difficulty in keeping these tanks full, careful pressure records were combined with flow measurements to determine the cause. These determinations showed that the maximum demands in the outskirts, near the tanks, had greatly increased until they represented a large percentage of total consumption. As a result there was a large loss of head in the feed mains from the pump station to the center of the city. It was further found that the allowable loss of head from the pumps to the tanks was completely used between the pump station and the downtown section, so that the tanks emptied rapidly in an effort to satisfy the heavy demands in the large area surrounding them.

The solution for this condition was to provide additional supply mains to the center of the high consumption area and from there to the areas drawing on the tanks. In this way a flat hydraulic grade line could be obtained and the tanks could be kept full except under the peak load periods for which they were designed.

Applications to Design

All these studies and measurements must obviously be correlated and intelligently used in the design of the improvements, to which they are only a preliminary. With the present strength of the system determined as described above, the first step is to obtain the maximum operating efficiency before designing any extensions. This is particularly important now, when critical war materials must be conserved. By correcting any existing faults in the system the required improvements can be kept to a minimum.

The actual design is divided into two sections: (1) the study and design relating principally to the main feed lines from the source of supply; and (2) the study and design for improvements of the gridiron of the distribution system.

1. *Main Feed Lines*

Under the first of these divisions it is usual to consider how the water may best be brought, without undue loss of head from friction, to certain sections where it is needed, in sufficient quantities and under all conditions of draft which are likely to occur, as determined in the studies. During the war, the possible means, except where priorities can be obtained, will be limited to the use of existing facilities or to the application of restrictions on the use of water. Cleaning has been mentioned. In addition it may

be possible to alter pumping procedure. In some cases direct pumping to reservoirs or tanks during periods of low consumption, by daily manipulation of certain valves, has been helpful. In other cases the transfer of existing pumping equipment to a new site and the formation of a booster district may temporarily solve a serious problem. Still another solution may be by the operation of pumps at a higher, though less efficient, head, to fill a reservoir or to prevent one from emptying.

Where priorities can be obtained, it is important to use only those mains which are the most urgently needed. These, however, should adequately solve the problem for which the priority was granted and it is highly desirable to have them fit into the long-range program. A distribution study based on field tests provides a rational means for selecting the mains needed now, with the assurance that they will do the job in the most efficient way.

Looking to the future when materials will again be available, however, a study should be made of the effect of tanks or balancing reservoirs, to supply the peak loads due to lawn sprinkling or fire fighting demands, thus reducing the size of mains otherwise needed.

2. *Extensions*

In the design of the extensions, hydraulic computations are made by use of the best available methods, depending on the particular problem. All methods use the same basic hydraulic principles and all are equally accurate for all practical purposes, *if* the proper assumptions are made. With actual information obtained from field tests, there is little danger of making erroneous assumptions. The mathematical methods, though sometimes too laborious, are used in conjunction with other methods for many problems. These computations are made for the period for which improvements are intended, so that it may be known approximately when each of the various items of construction should be undertaken if it is to be ready when needed.

This method of laying out work by a definite program results in an orderly procedure by the water plant in construction of new works. It provides an opportunity to make changes in construction dates for special reasons, such as unexpected pavement construction, with the assurance that the proper size is laid to fit into the general plan. It is this latter feature which will be so important after the war.

Great stress is being made today on the importance of having a public works program which will absorb the slack in industrial activity after the war. Undoubtedly water mains and street pavements will be an important part of this program and past experience with W.P.A. and P.W.A. will emphasize the importance of having on hand a well-engineered program for the construction of future water improvements.

Preparing the Valve System for Emergency Service

By Alvin J. Kuecker

IN WARTIME, the gate valves of a distribution system have a double virtue. They are used to shut off or control the flow of water when mains are broken or in other emergencies and to shut off certain areas, so that the balance of the system can function without interruption. Both these functions have been very important in the bombed cities of Europe, particularly in respect to fire protection.

The Elgin, Ill., Water Department has had experiences, similar to those of bombed areas, resulting from broken fire hydrants and mains. It is the purpose of this paper to report some of the facts and findings of the past twelve years of such experience.

Twelve years ago, the only distribution system record was a ten-year-old wall map, upon which there was no indication of any change in the system since the map was prepared. No valve or hydrant locations were shown; and investigation proved that in addition to being inadequate, the record was also inaccurate and totally unreliable.

To rectify this condition, the department started from the beginning to develop an entirely new record. A survey of the entire distribution system, showing main sizes, valves, fire hydrants and sprinkler lines, was made, showing the exact location of each item. After these data were compiled and a new set of wall and plat maps prepared, a valve inspection program was initiated.

The first step in this inspection involved opening and closing each valve, counting the number of turns necessary, checking the size of the valves and their direction of opening and making a careful search for leaks. Several hundred of the valves which had been in service since 1888 had no indicators of the direction of opening; but it was found that 48 of them opened to the right. In the case of valves found to be closed, or apparently closed, the entire main had to be shut off and the valves checked for direction of opening. About 90 per cent of the valves were set in manholes and most

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of them were covered with dirt and silt, some to a depth of two or three feet. In fact, some valves had to be dug out to determine their exact location, a total of some 27 yd. of mud and muck being hauled away when they were cleaned.

Most of the stuffing box bolts were found to be badly rusted or corroded. Those which could not be loosened were cut out and replaced. A rust preventative was painted on all bolts so that they could be turned easily in the future. Most valves had been packed with an oiled jute which had dried out and deteriorated. Evidence was found that leaking valves had been jammed open to stop the leaks.

Apparently this inspection, undertaken in 1932, was the first in the history of the system. The conditions revealed were deplorable: 224 valves were found to be broken, 86 were found closed and 36 could not be turned, or even moved, because their brass stems had frozen to the cast-iron stuffing boxes.

All information gathered in the survey was noted on loose-leaf notebook sheets and all pertinent findings were entered in a newly prepared street-intersection valve record book. The average cost for inspection and packing was $1.46 per valve, including valves varying in size from 4 to 20 in.

Valve Repair Procedure

With the completion of the inspection, parts were ordered for all broken valves, and repairs begun, taking care of the principal feeder mains first and the lines in outlying residential districts last.

To repair the immovable valves, a cup of clay was built up around the stem on top of the stuffing box and filled with penetrating oil. After 24 to 36 hr., this usually loosened the stem sufficiently to permit turning it. The stuffing box was then driven off and the stem scraped, greased and replaced. If the valves would not turn freely after greasing, the entire block of main in which the valve was located was shut off and a fire hydrant opened to give a flow sufficient to wash the corrosion off the seats and stem. Valves were never forced more than a quarter turn. If this did not free them, they were reopened and the hydrant flushing procedure resumed.

The most serious repair problem involved three 16-in. valves on a main feeder line from the pumping station to the heart of the city. Two of these valves were broken and the third bent so badly that it could be only partly closed. Since the cost of inserting new valves was prohibitive it was decided to repair them.

These repairs involved shutting off the water in twelve blocks. Consumers were notified a day in advance that water would be shut off at a certain time. In the meantime, valves were closed on the previous night

to determine whether or not the water could be shut off completely, and it was found that about 100 gpm. leaked through with all valves closed as tightly as possible. Also, during the day before actual repairs were started, the bolts had been taken out one at a time, greased and repaired, thereby saving considerable time in the night repair work.

With the start of repairs, two fire hydrants at the lower end of the area and one at a higher elevation were opened wide, thereby relieving the pressure on the area and draining off most of the water. A gas-engine ditch pump was used to pump off the water after the valve bonnets were raised. Three crews of three men each were then set to work on each valve, chiseling and hammering the corrosion off the gates and repairing the damaged parts. It required only four hours of work before service was resumed on the entire area.

It should be mentioned here that corrosion on the valve with the bent stem was so thick that a set of chain falls was required to pull the gates. This valve had undoubtedly been bent so badly in closing that it could be turned only about one-third open. From indications, it had been jammed in that position for a number of years.

With the job of repairs complete, it was found that total repair costs per valve were $36.40 and that the valves were as good as new. Had new valves been inserted, the cost would have been approximately $1,000 per valve.

By the fall of 1934, all broken valves had been repaired, so that the entire valve system was in perfect working order. Then, in 1936, a second inspection was undertaken. At that time, each valve was turned down, the number of turns counted and each valve was packed or furnished with new gaskets, if necessary. The cost of this inspection was only 43 cents per valve; and for the third inspection, in 1938, cost per valve dropped to 21 cents.

New Valve Maintenance Program

From all these inspections some important facts were discovered. It became evident, for instance, that in certain districts where the mains were laid by contractors, cheap competitive makes of valves had been installed. In one case, it was found that 21 valve stems had been broken by uninformed workmen trying to close open-right valves, twisting off the stem when the valve was open. For this reason the policy of checking valves before they are installed and indicating the direction and number of turns on worksheets or other records has been adopted.

In about 10 per cent of the cases of broken stems, tensile strength was found to be insufficient. Valves with badly corroded stems and gates had to be forced a little at a time and washed out, and in doing this it was

evident from the strain observed that they would break or bend. In respect to corrosion, it was also found that graphite packing did not deteriorate as badly as the previously used jute and that the rust preventative applied to the stuffing box bolts was effective, permitting the bolts and nuts to be removed easily.

The use of the field map and valve plat book on the second and third inspections made it possible to locate every valve immediately. Similarly the records of condition of valves that had been started with the first inspection proved their value. By their use it was possible to determine that the valves in the Elgin system should be inspected every two years. On a small number of valves that were timed in closing and opening and then not operated for a three-year period, inspection costs, at the end of the period, were found to be 29.3 cents each, or 8.3 cents more per valve.

Since all valves in the system are closed by hand, their operation becomes monotonous to the men responsible after a period of time. To assure the alertness of the personnel involved, however, the foreman is instructed to report whether any valve is found closed, and periodically the distribution system superintendent closes or partly closes one or two valves in a district just before an inspection is to be made. This not only gives a check on whether proper inspection is made, but brings out some interesting discussion by the men on the possible causes of such occurrences.

At the present time there are 1,439 valves in the Elgin system. On all these, no valve stem has been broken since 1936, and with the regular inspections, other maintenance costs have also been kept at a minimum. As a result of the new procedure, it is possible to say definitely that all valves are in good working order, that they can be shut off in a minimum of time and that they will close tightly. This is not only very inexpensive insurance for the Water Department, but also for the public, in assuring them of proper fire protection service.

Water Main Cleaning in the War Effort

By Clinton Inglee

THE Government has urged that all possible steps be taken to conserve critical materials. If current newspaper articles can be depended upon, manpower is also becoming a critical problem and the situation in that respect will become increasingly acute. Hence, anything that will conserve both materials and manpower will further the war effort.

It is obvious that the deferment of laying new mains, perhaps indefinitely, would result in large savings in both labor and materials. Thus, if requirements for increased capacity can be filled by the restoration of mains to their original capacity, the cleaning of old lines will certainly defer the laying of new mains, since cleaning will effect such restoration.

The methods and results of main cleaning have been described in numerous published articles, but it may be well to review the procedure briefly in the light of the present situation:

Mechanical cleaning requires opening the pipe in two places, inserting the cleaning machine and making up the pipe at place of entry, setting a riser pipe with a 45-degree bend at the other end of the run, propelling the machine through the pipe by water pressure or by cables (hand- or motor-drawn), and, finally, after emergence of the muddy water and the machine at the exit, shutting off the water, removing the riser pipe and reconnecting the main. The footage of pipe which may be cleaned in a single day will depend upon such factors as the amount and nature of the incrustation, tuberculation or deposit, the water pressure available, the layout of the system and the facilities for the discharge of wash water, and, not least important, upon the efficiency of the working crew. Prompt shut-offs and rapidity of cutting and making up determine whether one or more shots can be made in one day.

Mains of the smaller diameters cannot always be pressure-cleaned, but usually in 8-in. and larger pipe, the pressure-driven cleaning machines can

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be employed. Whether the smaller pipe is cleaned by the cable or the rotary method, the length to be cleaned in a single operation will depend

TABLE 1

Manhours Required for Cleaning Mains

1	2	3	4	5
MAIN DIAM.	LENGTH OF MAIN CLEANED PER DAY		NO. IN CREW	AVERAGE MAXIMUM MANHOURS PER MILE*
	Minimum	Maximum		
in.	*ft.*	*ft.*		
4	600	1,500	6	422
6	600	2,000	6	422
8	1,000	5,000	6	253
10	2,000	8,000	8	169
12	2,000	30,000	8	169
16	2,000	30,000	10	211
20	2,000	30,000	12	252
24	2,000	30,000	12	252
30	2,000	30,000	12	252
36	2,000	30,000	12	252

* Based on figures in column 2.

TABLE 2

Manhours Required for Laying New Mains

1	2	3	4	5*	6†	7‡	8‡	9	10§	11	12
MAIN DIAM.	WIDTH OF TRENCH	MATERIAL REMOVED PER MILE OF LENGTH		MANHOURS HAND DIGGING		MANHOURS PER MILE MACHINE TRENCHING		MANHOURS LAYING PIPE	MANHOURS BACKFILLING 3-FT. TRENCH	SUMS OF COLUMNS 5 + 9 + 10	SUMS OF COLUMNS 7 + 9 + 10
		3-ft. trench	5-ft. trench	3-ft. trench	5-ft. trench	3-ft. trench	5-ft. trench				
in.	*ft.*	*cu.yd.*	*cu.yd.*								
6	1.5	880	1465	700	1300	59	98	264	440	1404	763
8	1.65	968	1615	775	1435	64	108	295	484	1554	843
10	1.83	1070	1780	860	1580	71	119	365	535	1760	971
12	2.	1175	1960	940	1740	78	131	440	587	1967	1105
16	2.34	1372	2290	1100	2040	92	152	490	686	2276	1268
20	2.67	1592	2610	1270	2320	106	174	575	796	2641	1477
24	3.	1760	2930	1410	2610	117	195	705	880	2995	1702
30	3.5	2050	3420	1640	3020	136	228	880	1025	3545	2041
36	4.	2350	3910	1880	3430	157	260	1145	1175	4200	2477

* Based on man rating at 10 cu.yd. per 8-hr. day, or 1.25 cu.yd. per hr.

† Based on man rating at 9 cu.yd. per 8-hr. day, or 1.125 cu.yd. per hr.

‡ Based on cubic yards of material removed by machine with 2 men digging 800 ft. per day, 2 ft. wide, 4½ ft. deep, or approximately 30 cu.yd. per hr. This is probably much better than average.

§ Based on man rating at 16 cu.yd. per 8-hr. day, or 2 cu.yd. per hr.

upon the kind and location of bends and tees. In mains which are cleaned by pressure-driven machines, the factor of location and kind of bends is not too important, for the cleaning machines readily pass through 45- and 90-degree bends, except if two 90-degree bends are placed close together to make an offset, in which case it may be necessary to cut the pipe at that point.

The amount of pressure work which can be done in a working day is determined by the efficiency of the crew, which must cut and make up the line before and after the cleaning operations. The pressure cleaner should travel at a rate of approximately 100 fpm., i.e., at a little more than one 1 mph., so that it cannot be expected to clean more than about five 5 mi. of pipe in a working day. With overtime, however, it is possible to make even longer shots, the longest one, to the author's knowledge, being the cleaning of some 70,000 ft. of 12-in. cast-iron pipe at Cleveland, Ohio.

Comparison of Manhours for Cleaning and Laying

Under average conditions, it may be expected that the amount of pipe cleaned per working day will be approximately as shown in Table 1, from which, for purposes of comparison, only the minimum lengths of pipe, as shown in column 2, are used to derive the averages of column 5. Obviously, if longer runs than shown in column 2 are made, the manhours per run may be a trifle longer, but the manhours per mile of pipe cleaned will be less than shown in column 5.

In Table 2 are shown some manhour figures on the laying of new mains. These were derived from information in the handbook, *Estimating Construction Costs.** There may be some question as to the assumption that a man can take out 10 yd. of sand per day from a 3-ft. trench and 9 yd. from a 5-ft. trench, and that he can backfill at the rate of 16 yd. per day. Everyone should be guided by his own experience in this respect. The author's purpose has been merely to use a recognized authority for average figures. If labor is more efficient, the labor saving will be less. On the other hand, it is seldom that conditions are so favorable as to necessitate only 3-ft. trenching in sand. The deeper the digging and the more unfavorable the soil conditions, the greater will be the difference between the labor required for laying and for cleaning mains.

The factor of paving has not been considered here, but it is obvious that the holes, 6 or 8 ft. in length at various intervals, needed for cleaning compared with the continuous open trench required for pipe laying makes the cleaning alternative very attractive.

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* UNDERWOOD, G. *Estimating Construction Costs.* McGraw-Hill, New York (1930).

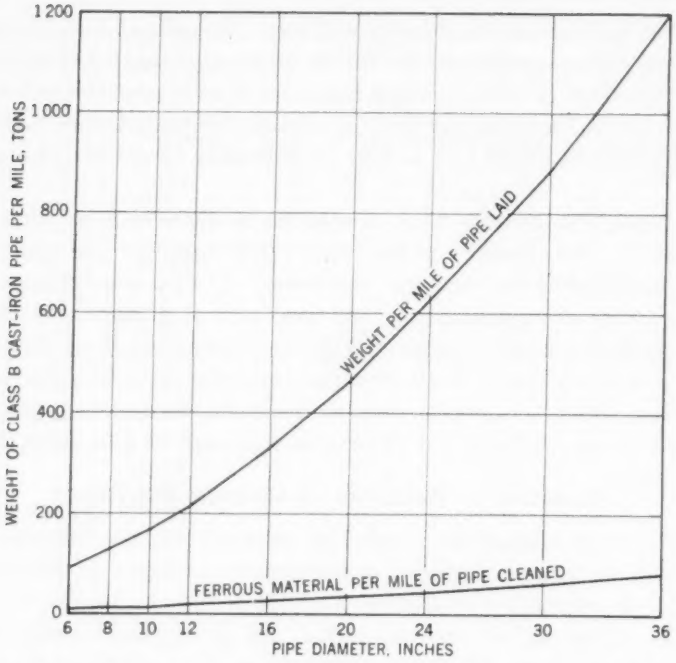


FIG. 1. Weight per Mile of Iron Required for Laying Mains Compared With Weight per Mile of Iron and Steel Used in Cleaning Mains

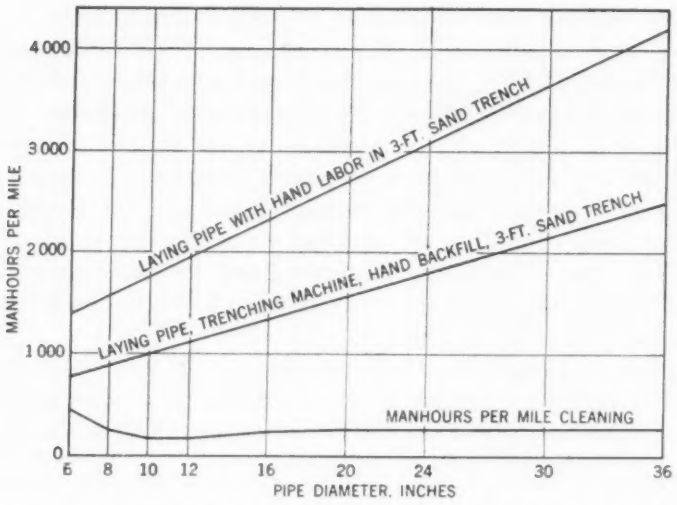


FIG. 2. Comparison of Manhours Required to Lay New Mains With Manhours Required to Clean Mains

In Table 3 and Figs. 1 and 2 comparisons are made of the ferrous materials used for laying cast-iron bell and spigot Class B pipe and those consumed per mile of water main cleaned and of the manhours required for each procedure. From this comparison, it will be noted that the amount of material required in cleaning is almost negligible.

In all of the above figures, costs are not mentioned, but obviously the savings in dollars will be in proportion to the savings in materials and manhours. In many instances, restoration of capacity, particularly in supply lines, has obviated the necessity for booster pumps and higher

TABLE 3

Comparison of Manhours and Ferrous Metals Required for Laying and for Cleaning Mains

MAIN DIAM.	LAYING MAINS			CLEANING MAINS	
	Manhours per mi. for Hand Work in 3 ft. of sand	Manhours per mi. for Trench Machine in 3 ft. of sand	Ferrous Metals per mi.*	Manhours per mi.	Ferrous Metals per mile†
in.			*lb.*		
6	1,404	763	176,000	422	1,900
8	1,554	843	250,800	253	2,500
10	1,760	971	336,600	169	2,325
12	1,967	1,105	433,400	169	3,000
16	2,276	1,268	660,000	211	4,500
20	2,641	1,477	924,000	252	6,100
24	2,995	1,702	1,232,000	252	8,100
30	3,545	2,041	1,760,000	252	11,600
36	4,200	2,477	2,398,000	252	15,600

* Using class "B" pipe.

† Average for all diameters, taken over a 5-yr. period, and arrived at by taking all steel purchased and dividing by the number of miles cleaned. This covered materials per mile as follows: $\frac{3}{4}$-in. cable, 27.14 lb.; $\frac{1}{4}$-in. cable, 0.34 lb.; $\frac{3}{16}$-in. cable, 22.52 lb.; high grade steel, 5.5 lb.; and other steels, 42.0 lb. To this 97.50 lb. per mile has been added weight of pipe and sleeves for repairing cleaning cuts.

pump pressures. Friction losses mean power losses and power costs, money. The reduction of friction losses saves power—another critical product.

Taking into account the vast governmental expenditures of today, it would seem that dollars are the last consideration with "Uncle Sam." This attitude cannot, however, be subscribed to by the water works operator. Both materials and labor represent money; therefore, the savings in materials and manhours to be achieved when the increased capacity to be obtained by cleaning will serve the purposes become a real issue in the economical operation of the plant.

Examples of Cleaning Benefits

Where pumping is necessary, reductions in friction losses by cleaning insure a reduction in power costs. A few examples will demonstrate the importance of this factor:

A 12-in. line in California, 35,338 ft. in length, was being used at greatly reduced capacity, as indicated by a Williams-Hazen coefficient of $C = 74$. Cleaning of this line raised the coefficient to $C = 121.3$. In other words, at a 2-mgd. flow, the increase in capacity represented a theoretical saving of about 95 hp.

The cleaning of an 8-in. line in a city in Texas made possible the postponement, for five years, of laying an additional line, thereby saving the city $1,000 per year on investment charges, or approximately five times the cost of cleaning.

A small city in Georgia reduced its pumping expense $200 per month by cleaning its supply line, out of which saving it paid for the cost of cleaning in six months.

In a small city in South Carolina, booster pumping was necessary prior to cleaning of its 12-in. raw water line. After cleaning, 30 per cent more water was delivered without the use of the booster pump. Information regarding the actual dollar value of savings in this case is not available, but the sum was considerable.

Similarly, in one of Georgia's large cities, a program of pipe cleaning in one section of the distribution system secured an 80-per cent increase in hydrant delivery, as evidenced by fire underwriters' tests.

Other examples of the benefits of main cleaning are offered in the experiences of various Army and Navy bases throughout the country:

At the naval base at Fort Sampson, N.Y., about 100,000 ft. of 12-in. used steel pipe was laid. It was decided that this old pipe could be cleaned more rapidly and at less expense after installation. A part of this project has already been completed.

To provide adequate service for the Illinois Ordnance Plant at Marion, Ill., 18,776 ft. of 14-in. supply line was recently cleaned.

At Fort Jay, N.Y., all mains from 6 to 10 in. in diameter, both for salt and fresh water, have been cleaned. The salt water lines were thoroughly sterilized and included in the fresh water system, so that the needs of the fort could be met with a small amount of inter-connection.

Other such projects have been undertaken at Fort Slocum, N.Y., Fort Andrews, Mass., Jefferson Barracks, Mo., Fort Jackson, S.C., Newport, R.I., Naval Torpedo Station, Fort Revere, Mass. and Bedloe's Island, N.Y.

Sterilization of New and Repaired Mains

By C. H. Billings

FOR many years before the institution of main sterilization practice, water works operators recognized the necessity for care in the laying of new mains and in the repair of distribution systems. The practices of flushing mains prior to their use and of employing special care in handling the pipe sections before their installation had been in use for a number of years before any thought was given to the additional precaution of sterilization. In fact, it was as late as 1925 before references to the chlorination of new mains began to appear in the literature of the field.

At that time, in spite of the knowledge that, by meticulous care in main-laying operations, new water systems could be installed without danger of contamination, sterilization practice was initiated for the control of those features of the operations which were particularly difficult to control by any other means. Just as the dairy industry practices pasteurization despite the knowledge that near sterile milk can be produced without it, the water works field adopted sterilization as an additional safeguard. It should be pointed out here, however, that its use is no license for carelessness in other features of main-laying procedure. The desirability to control as many factors as possible, using sterilization to provide for the factors of ignorance and error, should be understood by every water works operator.

After the first few years of experience with chlorine sterilization various problems of proper procedure became apparent. Among the early practices was that of placing dry calcium hypochlorite or chlorinated lime in each section of pipe as it was laid in the trench. This procedure was found undesirable primarily because it made impossible the flushing of the system prior to its disinfection. Also, as reported by Poole (1) in Indiana, many contractors were placing the chlorine compounds in the pipe weeks, or even months, before the water was admitted, with the natural result that sterilization was not at all effective. Still another objection, reported by

A paper presented on October 12, 1942, at the Southwest Section Meeting, Little Rock, Ark., by C. H. Billings, Chief Asst. Engr., Texas State Dept. of Health, Austin, Tex.

Calvert (2), was that, in admitting water to the mains following completion of installation, such high velocities were created that the upper ends of the pipe sections were not disinfected at all. In consequence of these findings, sterilization by liquid chlorine or by the injection of hypochlorite solution into the main after installation and following initial flushing is more widely recommended at the present time.

A.W.W.A. Specifications

By 1937, the confusing mass of recommendations and practices that had grown from the widespread and often uninformed experimentation with sterilization methods indicated the necessity for developing some standards of practice. Not long after, this need was met by incorporating recommendations of proper practice into the A.W.W.A. Specifications for Laying Cast-Iron Pipe (3).

In these specifications, it was pointed out that some methods were much more desirable than others. The methods given, using the following compounds, were indicated, in descending order of effectiveness, as: liquid chlorine water mixture, direct chlorine feed, calcium hypochlorite and water mixture, chlorinated lime and water mixture, dry hypochlorite, dry chlorinated lime. The specified point of application for the use of liquid chlorine water mixture or direct feed of chlorine is the beginning of the pipeline extension through a corporation cock. It is recommended that, in charging the main, the flow of water should be controlled at a low rate. The initial concentration of residual chlorine is given as 40 to 50 ppm. It is suggested that the detention period be long enough to destroy the non-spore-forming bacteria, or three hours or longer, and that the chlorine residual at the end of the period be at least 5 ppm. Further it is recommended that, following sterilization, the line should be flushed until the water throughout its length shows, upon test, that both chemically and bacteriologically it is equal to the water quality served the public from the existing system.

The specifications for the application of calcium hypochlorite or chlorinated lime in a water mixture call for the mixing of the material into a slurry to be injected or pumped into the line under the same conditions as specified for liquid chlorine application. The use of dry calcium hypochlorite or chlorinated lime is recommended only as an alternative procedure to be employed where facilities are not available for the other methods. The methods suggested for its application consist of shaking the dry powder into the pipe at the first joint attached to the existing water pipe, the dosage being repeated at intervals not greater than 100 ft., as the pipe laying progresses. After the application of the powder the newly laid section is to be charged slowly to avoid washing the powder to the end of the line.

Contamination by Jointing Materials

As a result of his investigations on methods of sterilization, conducted as part of the committee work for setting up the specifications, B. A. Poole (1) indicated that the suggested procedures were not entirely satisfactory, but represented the best known practice at that time. He has pointed out that although chlorination and flushing will eventually free a new water main of contamination, the amount of work involved makes the use of chlorine undesirable in certain systems, so that some new bactericide should be developed. It is claimed that one of the greatest difficulties in securing favorable bacteriological analyses following sterilization procedures is that jute, hemp or other jointing materials have been shown frequently to contain high numbers of bacteria and actually to support bacterial propogation. Separate sterilization procedures for jointing materials are recommended.

Calvert (2) states that chlorination of new mains laid with untreated hemp is futile, because the chlorine in the mains does not penetrate the hemp. He cites examples of aftergrowths of bacteria in pipes following sterilization, and reports that in his experiments jute was worse in this respect than hemp and that even yarns would support bacterial growth. As a solution to this problem, he has suggested the use of another bactericide, such as cupric ammonium or an organic mercurial sold under the trade name of "Klerol." He has also investigated the use of a substitute, consisting of a yarning material surrounded by heavy-walled rubber tubing.

Anderson (4) has pointed out that, in his experience with jute, a particular light-colored variety was found to be initially free from bacteria in most instances. He has also mentioned that leather seats in fire hydrants have been found contaminated and could not be disinfected with ordinary chlorine solution; and has worked with substitutes, particularly ordinary lime, both for the sterilization of jute and in actual sterilization of mains.

British Sterilization Practice

In Great Britain, practices are similar to those in this country. Gledhill and McCanlis (5) of the Sutton District Water Co. state that the practice of pouring chlorinated soda solution through a hydrant after a main had been installed was abandoned in favor of the use of portable chlorinators. The chlorine dosage and contact period is about the same as is recommended in this country.

Some thoughts the British have on the subject of care in the installation of new mains may be of interest. One writer indicates that consideration is being given to asking pipe manufacturers, after the war, to equip pipe sections, as they are shipped, with plugs which can be removed prior to

installation. Among practices mentioned in the literature are: sterilization of service lines, precut, in the shop, capping them until ready for installation; sterilization of meters with potassium permanganate, capping them until installed; and the requirement of Widal tests on employees to determine typhoid carriers.

The literature on wartime repairs in Britain emphasizes the essentiality of chlorine sterilization. Methods recommended seem to vary considerably. The philosophy is apparently to do the best one can under the conditions. Generally, a chlorinated lime slurry is used on small mains. Some employ liquid chlorine on the larger ones. One writer (6) does not consider it worth while to use mobile chlorinators on rush jobs. Some retention period is allowed where possible and, where feasible, customers are warned to boil drinking water until bacteriological results prove the safety of the water. Emphasis is also placed on cleaning out the line before repairs are begun.

In a recent JOURNAL article, Henry Berry (7), Chairman of the London Metropolitan Water Board, outlined the organization developed in London to carry out sterilization procedures and presented in detail a description of the methods employed, with instances of their application. His story is one of success under difficult conditions, but he points out that, even though successful results are indicated, it is realized that the method employed is a compromise between efficiency and expediency. In citing the fact that proper organization was the secret of success in this case, Berry says: "The efficiency of the chlorine process and the avoidance of delay must always depend upon the facilities provided, intelligent employment of them, constant vigilance and effort and the highest degree of co-operation between the engineering and the chlorination staffs."

This emphasis on organization is also indicated by Weir (8), Superintendent of the St. Louis County Water Company, in his suggestion that schools may be necessary to teach proper procedures in flushing and sterilizing mains.

Conclusions

The study of these reports and others (9–15), have led the author to the following conclusions:

1. The importance of care in main laying can not be stressed too highly.
2. Sterilization with chlorine is a desirable procedure, which, even though it does not present the easiest method available, appears to be the best known to common practice.
3. The use of chlorine in the repair of bomb-damaged mains is indispensable in Britain.
4. Its use has been shown to be successful.

5. No small measure of this success is due to the organization of repair work and training of crews, which is a lesson that all water works men should heed, particularly in the present emergency.

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Control of Chlorination

Committee Progress Report

THE work of the committee is incomplete, particularly with respect to the composition of the permanent standards for use with ortho-tolidine. It seems worth while however to state briefly the proposed changes in the present standard methods in advance of the publication of the completed report.

Using spectrophotometric methods of analysis, Chamberlin and Dragt found that the pH of a solution of chlorine in contact with ortho-tolidine should be 1.8 or less to assure pure clear yellow colors. For use in sewage, it is specified that the ortho-tolidine solution shall contain 180 ml. of concentrated hydrochloric acid per liter and this recommendation is to be made for the water section as well, in order to be assured of suitable pH.

Some difficulty has been experienced with the purity of ortho-tolidine. The ortho-tolidine dihydrochloride is obtainable in very much purer condition than ortho-tolidine itself. For this reason, ortho-tolidine dihydrochloride is recommended.

Hale recognized the necessity for using more ortho-tolidine in the range above 1 ppm. than was required below this point. Chamberlin studied the ortho-tolidine-chlorine ratio in considerable detail, using spectrophotometric methods of examination. He determined the limiting ratios and found that three parts by weight of ortho-tolidine are required for one part of chlorine. There is, however, considerable latitude above this ratio. This will be taken into account in the amount of reagent specified for the two ranges of residual chlorine.

Work done by Scott, although not entirely confirmed as yet, seems to show that, with suitable pH control, potassium dichromate without copper sulfate more nearly matches the ortho-tolidine-chlorine color. The new standards apparently may be viewed through varying depths, which is not true of the old standards.

A committee progress report presented on June 23, 1942, at the Chicago Conference, by C. K. Calvert, *Chairman*, Supt. of Purif., Indianapolis Water Co., Indianapolis, Ind.

It is the feeling of the committee that permanent standards prepared in most laboratories will be found to be less accurate than those commercially prepared. It will be recommended that commercially prepared standards be used by the great majority of laboratories.

Through the years, hydrochloric acid has come into use in this iodimetric method. The acetic acid, as originally proposed, should be used instead of hydrochloric acid, thereby removing much of the objection to the iodimetric estimation of residual chlorine. The neutral starch iodide method is especially attractive when interfering substances are present. The iodimetric method is used as a basis for the standardization of ortho-tolidine permanent standards; consequently the iodimetric method will be given more prominence than it was in *Standard Methods*.*

In estimating available chlorine in hypochlorites, the acid iodimetric method is essential. Neutral titration gives low results. Break-point runs using chlorine water should check with those using hypochlorite only when hypochlorite is standardized by an acid iodimetric titration. The exact method in which the available chlorine in hypochlorites must be carried out will be given.

The titrometer is an instrument which utilizes a type of amperometric titration with sodium arsenite in which the phenomenon of electrode polarization is exhibited. It was described by Marks and Glass† at the A.W.W.A.'s Toronto Convention. This instrument provides the only accurate means now known for measuring separately the amount of free chlorine and combined chlorine (chloramine) in a mixture of the two. By this method, chlorine residuals can be determined between pH values of 6.5 and 8.0 without pH adjustment. It is hardly applicable for use in a small water plant, but is valuable for use in larger plants and in research.

If great accuracy is required in the measurement of chlorine residuals above 10 ppm., an iodimetric method must be used. Generally a close approximation suffices in high residuals. The drop dilution method yields such accuracy. In its essentials the method consists of adding a certain number of drops of the sample to distilled water containing ortho-tolidine in a comparator cell. After reading the color and knowing the number of drops per milliliter, a simple calculation gives the approximate result.

In the presence of free chlorine the Laux flash test shows instantaneously developed color on the addition of ortho-tolidine. In the Laux and Nickel test (*see* page 1785, in this issue of the JOURNAL), the addition of low acid ortho-tolidine or the dihydrochloride, without acid added, gives a blue

* *Standard Methods for the Examination of Water and Sewage*. Am. Public Health Assn. & Am. Water Works Assn., New York (8th ed., 1936).

† MARKS, H. C., AND GLASS, J. R. A New Method of Determining Residual Chlorine. Jour. A.W.W.A., **34:** 1227 (1942).

color instantaneously in the presence of free chlorine. The blue color is a bit easier to see than the yellow. With practice, as little as 0.2 ppm. free chlorine may be detected. The dihydrochloride without acid has the advantage of showing no color at all with chloramine, even after several minutes contact.

Since break-point chlorination has been developed since the latest edition of *Standard Methods*, the detail of making this test, as well as the interpretation of the results, will be included. The chlorine demand test has been modified on the basis of experience at Buffalo and elsewhere.

Doubtless the proposed methods are not final and will require revision later, but the committee hopes that improvements have been made which will be helpful in controlling the treatment of water.

Erratum

Ground Water—A Vital National Resource—Midwest Problems, by CHARLES B. BURDICK, in the November 1942 issue, page 1613, Fig. 2:

The curves for "Galleries (Des Moines)" and "Wells (Peoria)" should be reversed from their second point of intersection—December 1938—to the end of the plotting. A corrected diagram is shown below:

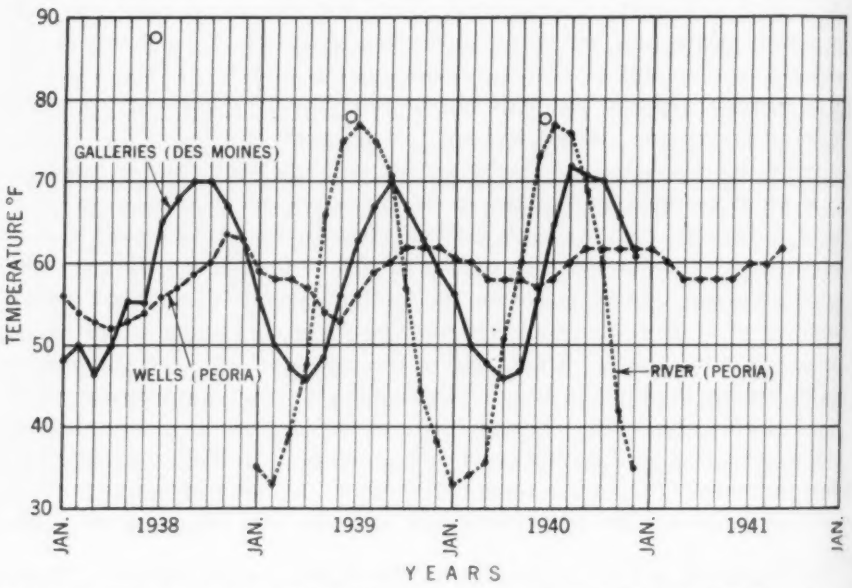


FIG. 2. River and Ground-Water Temperatures at Peoria, Ill., and Infiltration-Gallery-Water Temperature at Des Moines, Iowa, 1938–41

(NOTE: Circles indicate average air temperature of warmest month.)

A Modification of the Flash Color Test to Control Break-Point Chlorination

By Paul C. Laux and J. B. Nickel

BREAK-POINT chlorination has a definite place in water treatment for taste control, and the flash ortho-tolidine color test is an effective method of regulating plant dosages. The hesitancy to use this method may be attributed to the fact that it must be accurately performed, carefully watched and properly interpreted, if results are to be accurate. Therefore, the authors studied the test thoroughly to find a modification that would be simpler and less rigid in its requirements and more positive in its results.

The result of this work was the development of an ortho-tolidine solution with a very low acid content. It was found that an ortho-tolidine solution which contains only 1–10 ml. hydrochloric acid per liter inhibits all color development until break-point dosages have been slightly exceeded. When this solution is added to waters chlorinated beyond the break-point, it develops an instant blue or yellow color. With waters of fairly low pH, the color develops and remains blue. Waters of about pH 7.9 develop a blue color which instantly turns yellow; and in waters of still higher pH, the color flashes in yellow or orange and does not change. The color intensity increases with increasing chlorine residuals.

The ortho-tolidine solution used may be prepared by grinding 1 g. of ortho-tolidine powder thoroughly in a 6-in. hard glass mortar, adding 5 ml. of a previously prepared acid solution (1 or 10 ml. hydrochloric acid diluted to 100 ml.) and grinding the mixture to a thin smooth paste. This paste should then be rinsed into a 1-l. volumetric flask, the flask partially filled with distilled water, shaken thoroughly and filled to the mark with distilled water.

In using this type of solution for plant control of chlorine dosages, residual chlorine readings should be made as usual. The modified ortho-

A contribution by Paul C. Laux, City Chemist, Anderson, Ind., and J. B. Nickel, Sales Engr., The Tennessee Corp., Atlanta, Ga. and Lockland, Ohio.

tolidine solution should be used only to determine whether or not break-point chlorination has been exceeded. Sufficient time must elapse between the chlorine application and the addition of the ortho-tolidine solution to permit complete reaction between the chlorine and ammonia. At room temperature, a 20-min. period is sufficient; with waters near freezing, a period of 45 min. is satisfactory.

The use of the solution in plant dosage control is simple. To 100 ml. of the sample, measured into a flask or beaker, 1 ml. of the solution should be added and the contents of the flask swirled. If a definite color appears instantly, break-point chlorination has been attained. Otherwise, the residual chlorine is just at or below the break-point.

Numerous laboratory experiments indicate that this method is applicable to waters varying in pH from 6.2 to 9.5, regardless of the chlorine demand. Many waters used in the tests were synthetically prepared; others were natural waters collected from a variety of sources. Although consistent results were always obtained, much research should be carried out on all types of water used for public supply.

Discussion by *C. K. Calvert*.* In several experimental break-point runs and for a short time in plant operation a solution of 1.34 g. of ortho-tolidine dihydrochloride per liter was used in parallel with the reagent prepared according to the method described by the authors. In this technique, rather than using a beaker or a flask, the sample was examined in a Nessler tube. The reagent was squirted with some force.

It was found that the blue color did not develop before the break-point, but that somewhat less than 0.5 ppm. free chlorine beyond the break-point produced a rather easily visible blue color.

Apparently a blue color is slightly more visible than a yellow. The dihydrochloride tends to produce a blue color because it contains almost no acid, yet is easily soluble in distilled water.

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Chlorine Residual and Bacteriological Quality

By Max Levine, Austin Heller and Richard Bender

THE problem of the relation of chlorine residual to bacteriological quality of drinking waters resolves itself, in a sense, into whether a stipulated residual may be employed as an index of safety in respect to bacterial quality and hazard of transmission of disease. In any disinfection process, effectiveness is determined by such factors as the concentration of the germicide, the temperature and reaction of the substratum, the opportunity for direct contact of the germicide with, and its rate of penetration into, the cell being disinfected. If the disinfectant reacts with constituents in the substrate, the characteristics of the products formed, the extent to which they function as germicides and their effect on the determination and the apparent concentration of the germicide must be considered. The last item is of particular importance in conjunction with the use of chlorine in water sterilization, because of its extreme reactivity and tendency to form chlorine substitution and oxidation products.

In the presence of ammonia, chloramines may be formed which will affect the determination and germicidal efficiency of chlorine residuals; turbidity may result in adsorbtion of chlorine, and clumps of bacteria or organic suspended particles will mechanically protect the bacteria against contact with the germicide. The initial bacterial load is also a factor which must be considered in conjunction with the reliability of a stipulated residual, for a given contact period, as an index of safety.

The method of determination of residual chlorine, the point of sampling, whether at the plant shortly after chlorination or at a tap at the point of delivery to the consumer, will influence opinion or conception as to what constitutes an adequate residual. A factor which is perhaps generally not adequately considered is the point of bacterial analysis of the sample, that is, whether the interpretation of bacterial findings with respect to residual

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chlorine is to be based on analysis immediately (or shortly) after collection, or at some distant laboratory and, if the latter, whether de-chlorination was effected at the time of sampling.

Thus, many problems are involved in an adequate and all-inclusive answer to the question, "What constitutes an adequate chlorine residual?" since a number of physical and chemical environmental factors markedly influence the germicidal efficiency of chlorine and chlorine residuals. The following discussion will be concerned primarily with residuals ascertained at stipulated times after chlorination before the water is admitted to the general distribution system.

Chlorine Residuals by Various Methods

In Table 1 are presented data showing the relation of initial chlorine to chlorine residual. These data illustrate the now well-known phenomenon of break-point chlorination and the necessity for designating the method

TABLE 1

Relation of Initial Dose and Method of Determination to Residual Chlorine

METHOD OF DETERMINATION		RESIDUAL CHLORINE, IN PPM., AFTER 2 HR., FOR VARIOUS INITIAL CHLORINE CONCENTRATIONS				
		Series A 0.85 ppm.	Series B 2.10 ppm.	Series C 2.35 ppm.	Series D 2.6 ppm.	Series E 2.85 ppm.
Ortho-tolidine		0.4	0.3	0.22	0.26	0.4
Starch Iodide	Neutral	0.52	0.37	0.25	0.22	0.42
	Acid	0.70	0.55	0.31	0.53	0.60
Arsenite—Neutral		0.60	0.41	0.35	0.36	0.50
Electrometric Chlorine	HOCl	0.0	0.0	0.0	0.21	0.41
	NH_2Cl	0.43	0.34	0.21	0.07	0.06
	Total	0.43	0.34	0.21	0.28	0.47

of determination when referring to chlorine residuals. Thus, in series B, C and D, with initial chlorine concentrations of 2.10, 2.35 and 2.6 ppm., the residuals, after 2 hr., were not markedly different (namely, 0.3, 0.22 and 0.26 ppm. respectively) when determined by ortho-tolidine. They were approximately 0.1 ppm. higher for each of the series, however, when determined by the neutral arsenite titration, and very much higher, particularly for series B and D (0.55 and 0.53 ppm.), when determined by acid starch iodide.

In these particular series, the electrometric chlorine determinations were remarkably close to the ortho-tolidine and neutral starch iodide titration figures. It will be noted that, whereas in series B and C all of the chlorine present was in the form of chloramine, the residual in series D was primarily hypochlorite.

Comparing series A and E, in which initial chlorine concentrations were 0.85 and 2.85 ppm., respectively, the residual chlorine by ortho-tolidine test in both instances was 0.4 ppm., while other methods of determination gave results up to 0.7 ppm., the results for series A being uniformly 0.1 ppm. higher than for series D.

As was to be anticipated, the electrometric determinations disclosed that all of the residual in series A existed in the form of chloramine, whereas that of series E was almost entirely hypochlorous acid (chlorine).

Reports of Calvert, Griffin, Harvill, Levine and co-workers, and numerous others have demonstrated a much greater rate of death of bacteria when employing stipulated residuals as hypochlorous acid than with chloramine.

It might be noted that the differences in chlorine residuals determined by different methods were in some instances as great as, or greater than, 0.2 ppm., which has sometimes been considered adequate for safety. These data therefore serve to emphasize again the importance of stipulating the method of determination and of indicating whether a chloramine or a chlorine (HOCl) residual is under consideration.

Chlorine Residuals and Incidence of Gas Formers

The following data were obtained in conjunction with a study undertaken for the purpose of ascertaining the nature of non-spore-forming organisms surviving routine water purification processes. Samples were submitted weekly for a period of about a year by four Midwestern cities which will be referred to hereafter as cities A, B, C and D.

City A obtains its water from a lake, treatment consisting of ammonia-chlorine sterilization with residuals generally around 0.35 ppm. (range, 0.25 to 0.5 ppm.) after 1.3 hr. contact.

City B obtains its water from a river, treatment consisting of sedimentation, coagulation, filtration and ammonia-chlorine sterilization. Residuals are maintained at 0.2 to 0.45 ppm., the contact period being 6 hr.

City C obtains its water from a river, also employing complete treatment (sedimentation, coagulation, filtration and chlorination). Chlorine residuals are kept quite constant, at approximately 0.25 to 0.35 ppm., with a contact period of 12.5 hr.

City D obtains its water from a river, treatment consisting of sedimentation, coagulation and chlorination. Residuals of 0.4 to 0.6 ppm. are maintained during the winter, when chlorine alone is employed, and are increased to 0.8 to 1.0 ppm. for the summer, when ammonia-chlorine is used. These residuals were obtained after 48 to 72 hr. contact.

Samples collected in triplicate by these cities were submitted weekly. One was examined immediately at each city's water works laboratory. The other two were de-chlorinated, by adding sodium sulfite, and shipped

un-iced, *via* special delivery, to the authors' laboratory at Ames, Iowa. Samples from cities A, C, and D reached Ames within 12 hr. whereas samples from city B arrived 24 hr. after collection. There was no evidence of any appreciable change in temperature of the samples during shipment.

On arrival at the Ames laboratory, one sample was examined immediately for bacterial count (agar, 24 hr., 37°C.) and incidence of gas-forming bacteria; the other was stored at 28°C. for two days after which it, too, was examined for incidence of gas-forming bacteria.

TABLE 2

Chlorine Residual and Detection of Gas Formers at Point of Origin of Samples

CHLORINE RESIDUAL IN PPM.*	NO. OF TUBES SHOWING GAS AND NO. CONFIRMED, BY CITIES†									
	City A		City B		City C		City D		Total	
	Gas	Conf.	Gas	Conf.	Gas	Conf.	Gas	Conf.	Gas	Conf.
Less than 0.2	—	—	10	0	—	—	—	—	10	0
0.2–0.39	17	11	—	—	59	4	8	1	84	16
0.4–0.59	9	0	26	2	—	—	22	0	57	2
0.6–0.79	—	—	—	—	—	—	8	0	8	0
0.8–0.99	—	—	—	—	—	—	1	1	1	1
Total	26	11	36	2	59	4	39	2	160	19
Percentage of Total Portions Tested	20	8.5	27.5	1.5	45.5	3.1	27	1.4	30	3.6
Source	Lake		River		River		River			
Treatment‡	Ch		Co, F, Ch		Co, F, Ch		Co, Ch			
Contact Period, *hr.*	1.3		6		12.5		48–72			

* As reported by co-operating city; method not always designated—residual presumably chloramine.

† Each city examined 130 10-ml. portions, the total of 520 being reported in the last column.

‡ Key: Ch—chlorination; F—filtration; Co—coagulation.

In Table 2 is shown the distribution of gas formers with respect to chlorine residuals, all of which were presumably chloramine, as determined in the laboratories at the point of origin of the samples. It will be noted that each of the cities met the U.S. Public Health Service standards with respect to incidence of coliform bacteria in 10 ml. portions, the percentage positive confirmations being 8.5, 1.5, 3.1 and 1.4, respectively. The proportion of 10-ml. samples showing gas-forming organisms varied from a minimum of 20 per cent for city A to a maximum of 45 per cent for city C.

Except for two instances in city B coliform bacteria were not encountered when residuals of 0.4 ppm. or more were maintained. It should be noted that non-confirming gas formers were frequently encountered with residuals of 0.4 to 0.6 ppm., and, at times, even in the presence of 0.6 to 0.8 ppm., after contact periods of 48 to 72 hr. These gas formers were not members of the coliform group. It appears that there is no particular relation between the proportion of tubes examined showing gas to the number of tubes confirmed for members of coliform group. The data indicate the futility of stipulating absence of gas formers of all kinds unless superchlorination or extremely high residuals are attained and maintained for very long periods.

Effect of De-chlorination and Storage on Incidence Gas Formers

It has frequently been observed that the incidence of gas formers and coliform bacteria is higher in tap samples than in the water treatment plant effluent. Among the suggestions which have been put forth to explain this phenomenon is the possibility that the freshly chlorinated organisms which have not succumbed at the time of sampling are nevertheless injured so that they exhibit a long lag phase and hence are not detected in the primary fermentation tubes when employing a limited (48 hr.) incubation period. On the other hand, such injured organisms remaining in a distribution system may gradually recover so that when they are encountered they no longer show this long lag phase in growth and are consequently detected in the course of routine analysis.

It was thought that the procedure of de-chlorinating samples, then shipping them to a distant laboratory or storing them, would simulate conditions encountered in mains with respect to chlorine injury and possible recovery of micro-organisms and that examination of such samples for incidence of gas formers might throw some light on whether the foregoing hypothesis is at all well founded. In Table 3 are presented the results of analyses of samples made immediately upon their arrival at the Ames laboratory and after storage for 48 hr. at 28°C. in comparison with the determinations made at the point of origin, that is, at each water works' laboratory.

The most striking fact shown by this table is that, in three of the cities, the numbers of gas formers and the numbers of confirmations reported by their laboratories were considerably higher than were obtained at the Ames laboratory, whereas in the fourth city, the reverse was true. Also evident from a comparison of the results obtained in the Ames laboratory for samples examined immediately upon arrival with those examined after storage for 48 hr. was the fact that storage tended to suppress the gas-forming organisms, this being true for both the non-confirming and the coliform bacteria.

If samples shipped to a distant laboratory for examination are not de-chlorinated, abnormally low coliform indices will be obtained because of the continued germicidal action of the chlorine residuals, whereas, if de-chlorinated, low indices will tend to be obtained because of overgrowth of the miscellaneous types of bacteria present (some of which may interfere with growth of coliform bacteria in lactose broth) or death of coli-like bacteria in transit. The data indicate quite clearly the hazard involved in examination of shipped samples, even when de-chlorinated, for the detection of gas-forming and coliform bacteria, and that indices for such bacteria in shipped samples are very likely to be lower than at the point of collection.

TABLE 3

Effect of De-Chlorination and Storage on Detection of Gas Formers

PLACE OF EXAMINATION	TIME OF EXAMINATION	TREATMENT	NO. OF PORTIONS SHOWING GAS AND NO. CONFIRMED, BY CITIES							
			City A		City B		City C		City D	
			Gas	Conf.	Gas	Conf.	Gas	Conf.	Gas	Conf.
Source	Immediately	Not de-chlorinated	28	11	47	1	57	6	40	2
Ames	On Arrival	De-chlorinated	9	3	0	0	69	13	22	0
Ames	After 48-hr. Storage at 28°C.	De-chlorinated	6	0	0	0	32	9	12	0
Residual Chlorine, *ppm*			0.3–0.5		0.1–0.45		0.3–0.35		0.4–1.0	
Contact Period, *hr*			1.5		6		12		48–72	
10-ml. Portions Tested			135		130		145		145	

The data further indicate that the higher incidence of gas formers and coliform bacteria sometimes encountered in distribution systems as compared with treatment plant effluents is probably not due to recovery and consequent detection of organisms which have been partially injured by chlorination but, barring reinfection, is more likely due to aftergrowth of gas formers and coliform organisms which have found favorable conditions for growth in localized areas in the water mains.

Types of Non-Spore-Forming Organisms Surviving Chlorination

In the determination of incidence of coliform and other gas-forming organisms, various portions of water were inoculated in duplicate into lactose broth, one set incubated at 37° and the other at 28–30°C. When gas was present, E.M.B. agar and MacConkey agar plates were streaked and incubated at temperatures corresponding to those of the initial positive lactose broth tubes. Bacterial counts were made by plating out 5-ml.

and 1-ml. portions in duplicate on nutrient agar. A large number of colonies were fished from both the nutrient agar and differential agar media, irrespective of whether they resembled coliform bacteria or not, for the purpose of ascertaining the types of organisms that survived chlorination.

In addition to samples from the four cities referred to above, cultures were submitted by two Eastern cities which co-operated in this study. Over 1,600 cultures were fished. Of these, 177 were members of the coliform group and 223 were selected to be representative, with respect to type and relative incidence, of non-spore-forming organisms other than the coliform group and subjected to a detailed study.

Of the 177 strains in the coliform group, 108 (61.1 per cent) were members of the genus *Aerobacter*, 33 (18.7 per cent) were intermediate or *Citrobacter* types and 36 (20.2 per cent) were in the genus *Escherichia*.

As is shown in Table 4, the 223 non-spore-forming organisms, other than those of the coliform group studied, fell into 7 genera.

The spherical forms included 4 strains of *Sarcina* and 19 of the genus *Micrococcus*.

Among the rod-shaped bacteria, pigmented strains were very common, particularly those producing water-soluble fluorescent pigments, i.e., members of the genus *Pseudomonas*, which constituted by far the largest group (111 strains), and members of the genus *Flavobacterium*, where 8 strains were placed because of the intense yellow water-insoluble pigment which they produced.

Of the remaining organisms, all of which were non-chromogenic Gram-negative short rods, one resembled *Shigella ceylonensis*, 8 were allocated to the genus *Proteus*, but differed from the described species in that they produced acetyl-methyl-carbinol (Voges-Proskauer positive). It is possible, however, that further study may have shown them to be very slow lactose fermenters of the *Aerobacter cloacae* type. The remaining 72 strains were allocated to genus *Achromobacter*, which harbors non-pathogenic forms.

In Table 4 are shown some of the characteristics of these organisms with respect to their biochemical activities—proteolytic, lipolytic and oxidase reactions.

The high incidence of chromogenic forms is particularly striking and is in line with the report of Charleton who found that organisms producing greenish fluorescence were very frequently present, sometimes in practically pure culture, in chlorinated surface water supplies and that in swimming pools containing 0.4 to 0.5 ppm. residual chlorine, pigmented forms of the genera *Flavobacterium*, *Sarcina* and *Pseudomonas* were characteristically predominant.

In this study it was observed that many of the pigmented forms did not grow at 37°C. This was particularly true of members of the genus *Pseudo-*

monas, only 40 (36 per cent) of the 111 strains studied growing at the body temperature—*Pseudomonas pyocyanea* not being encountered among them.

The question of pathogenicity of members of the genus *Pseudomonas* has frequently been raised and their rôle as incitants of enteric disease is in need of clarification. Fluorescent bacteria are not uncommonly found in soil or unpolluted waters, and in fact, wherever organic matter is undergoing decomposition. Some strains have been associated with production of blue coloration in milk, off-flavors in dairy products, green whites in eggs and green discoloration of surgical dressings employed for suppurating infections. Among pathogenic species of fluorescent bacteria are included strains which are responsible for disease in caterpillars, chickens and

TABLE 4

Distribution and Characteristic Reactions of Strains Which Do Not Produce Spores or Gas From Lactose Among Bacterial Genera Isolated from Chlorinated Water

GENUS	NO. OF STRAINS	PROTEOLYTIC		LIPOLYTIC		OXIDASE	
		No.	%	No.	%	No.	%
Pseudomonas	111*	63	57	65	59	45	41
Achromobacter	72†	14	19	38	53	35	49
Micrococcus	19	8	42	8	42	0	0
Proteus	8	0	0	2	25	2	25
Flavobacterium	8	5	63	1	13	2	25
Sarcina	4	4	100	0	0	0	0
Shigella	1	—	—	—	—	—	—
Total	223	94	42	114	51	84	38

* 71 strains did not grow at 37°C.
† 28 strains did not grow at 37°C.

reptiles and one species, *Pseudomonas pyocyanea*, which differs from most of the fluorescent bacteria in that it grows luxuriantly at 37°C. and is characterized particularly by ability to produce a chloroform-soluble blue pigment, "pyocyanin," has been associated with various pathological processes in man.

This species has been encountered frequently in pure culture in abscesses, particularly in middle-ear infections, and cases of endocarditis and pneumonia have been attributed to it. In 1898, in an outbreak of dysentery in New York State, a well was implicated and *Pseudomonas pyocyanea* was thought to be the causative agent, the organism being found to be quite abundant in the well water and in stools of the patients. Intra-peritoneal injection of rabbits with large quantities of filtrates of broth cultures have been shown to be toxic and even fatal, one of the symptoms being diarrhea.

Aftergrowths, so frequently encountered in remote portions of water distribution systems and particularly in small water storage tanks, seem to be due primarily to growths of these fluorescent types of bacteria. It will be noted from the data in Table 4 that a large proportion of the strains of *Pseudomonas* and *Achromobacter*, in marked contrast to the other genera listed, are proteolytic, lipolytic and oxidative. It is therefore not surprising to find these genera frequently associated with development of off-tastes and off-flavors in dairy and other food products.

The frequency with which these types of non-spore-forming bacteria have been encountered in water supplies which have conformed to the U.S. Public Health Service bacteriological standards for drinking water indicates that they are more resistant to chlorination than are the coliform bacteria. Although many more data must be accumulated before a definite answer can be given as to the concentration of chlorine necessary for their control, it is suggested that a residual of 0.5 to 0.6 ppm. for at least an hour might be required for members of the genera *Pseudomonas* and *Achromobacter*.

Whether the presence of fluorescent bacteria, in general, or *Pseudomonas pyocyanea*, specifically, is to be considered as an index of lack of safety of a water supply, with respect to enteric disturbance, is still a moot question; but that their presence is undesirable in waters used for elaboration of food products, because of the deterioration they incite, seems definitely proved. Treatment of water to control the incidence of these types of organisms should be a step in advance towards further improving bacteriological quality of domestic and industrial water supplies.

Summary

1. Coliform indices on samples shipped any considerable distance for analysis are likely to be lower than at the point of collection, even if they are de-chlorinated before shipment.

2. The fact that incidence of gas formers and coliform bacteria encountered in distribution systems is sometimes higher than at the water treatment plant effluent, aside from the possibility of reinfection, is not due to recovery of cells partially injured by chlorine, but rather to the existence of points in the system where gas-producing bacteria find favorable conditions for growth.

3. The green-pigment-producing genus *Pseudomonas* and the non-chromogenic *Achromobacter* were the predominant types of non-spore-forming bacteria which survived chlorination and these are frequently responsible for aftergrowths. Members of the genus *Achromobacter* are non-pathogenic. One species of *Pseudomonas* (*Pseudomonas pyocyanea*) has been associated with pyogenic infections and is the cause of green pus

in suppurating wounds, but its rôle as an intestinal pathogen has not as yet been definitely established. *Pseudomonas pyocyanea* was not encountered among the 111 strains of fluorescent bacteria studied.

4. Members of the genera *Pseudomonas* and *Achromobacter*, because of their biochemical activity as oxidizers and fat and protein digesters, have not infrequently been responsible for deterioration of food products, particularly the production of off-tastes and flavors, green coloration of egg whites and milk; and their presence might interfere with detection of coliform bacteria. Adequate control of such organisms would therefore seem to be indicated from the standpoint of highest bacterial quality.

5. The difference in chlorine residuals determined by various methods was, in many cases, found to be as great as or greater than 0.2 ppm., a concentration which has sometimes been considered adequate for safety. It is suggested that variations in reports in the literature regarding the reliability of such a residual might be due in part to the variation in determination of residual by different procedures. The necessity for stipulating the method of determination as well as the residual chlorine must be emphasized continually.

6. In one city supply non-conforming gas formers were not eliminated by chlorination to residuals of 0.6 to 0.79 ppm. even with a contact period of 48 hr. Therefore it appears futile, at this time, to set standards of quality which would require the practical elimination of spore-forming aerogenic organisms without, at the same time, stipulating superchlorination.

7. Stipulation of a chlorine residual which would be universally applicable as an index of safety does not seem feasible because of the marked variations in the physical and chemical characteristics of different waters. When a minimum residual is stipulated for a given water supply, it should be understood that dropping below this minimum might be hazardous, but that attaining that point is not in itself a sign of absolute safety. The bacteriological test must remain the ultimate criterion of safety.

8. Residuals of 0.3 to 0.4 ppm. ahead of, or 0.2 ppm. beyond, the chlorination break-point, for at least 30 min. may be considered a reasonable index of safety, with respect to incidence of coliform organisms, for a water discharged into a distribution system.

9. To control members of the genera *Pseudomonas* and *Achromobacter*, residuals of 0.5 to 0.6 ppm. as chloramine or 0.2 ppm. as chlorine for a period of an hour may be necessary, but data now available are meager.

Maintenance of Chlorine Residual in the Distribution System

By Clyde R. Harvill, J. H. Morgan, Major C. Hagar and Arthur R. Todd

Houston, Tex.—Clyde R. Harvill and J. H. Morgan

ANY discussion of the maintenance of chlorine residuals in the Houston distribution system must, of necessity, be prefaced by a brief description of the physical aspects of that system so that the several unusual problems that tend to impede the maintenance of the residual may be understood.

The Houston public water supply consists of six inter-connected water systems, each of which has its own battery of deep artesian wells and storage reservoirs and each of which, during normal operation, supplies a more or less well defined portion of the distribution system. This peculiar type of construction is the result of the necessity for the spreading out of well fields to prevent interference and of the rapid growth of the city during the last thirty-six years, from 50,000 population in 1906 to 400,000 today. As the city grew, it annexed the small towns and subdivisions adjacent to it and fell heir to their water systems. As a consequence of this development, the Houston water distribution system can now best be described as a wheel-pattern grid system with one plant occupying the hub position and the other five scattered in rim positions.

In a system of this type there exist so-called "surge point" areas lying between the six plants. In these areas the water remains static or flows back and forth over a distance of a few blocks, depending upon the operation of the plants. As far as quality of the water is concerned, such areas can be considered dead ends.

During recent years the system has been strengthened by the laying of some large feeder mains, connected by laterals, and by provision of a small

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amount of elevated storage. Further expansion of the system, however, has been characterized, in general, by the addition of dead-end lines to the wheel grid to supply new consumers. These dead ends have been the only method by which the department could meet the rapid expansion of the city, since a Texas State Supreme Court decision prevented the issuance of construction bonds, making the financing of all new construction dependent upon current surplus revenue. At the present time there are 222 dead ends in the system.

Prior to 1929, the Houston water supply was not treated. The supply, with an average hardness of 50 ppm., as $CaCO_3$, required no softening and since it was obtained from artesian wells averaging 1,800 feet in depth, the supply was considered satisfactory for domestic consumption. In June 1929, however, a flood inundated several of the wells, and the Central Water Plant. Experience in this emergency resulted in the formation of the Sanitation Section of the Water Department. Chlorination of the water supply was started immediately and since that time the supply has received satisfactory certification ratings.

Taste and Odor Problems

In examining the distribution system to ascertain the effectiveness of the bactericidal action of this first chlorination, it was demonstrated conclusively that, where a chlorine residual was maintained in the distribution system, no tastes or odors developed. During the following thirteen years, then, various means were utilized in an attempt to maintain and extend this chlorine residual. In 1933, chloramination was initiated. In 1939, automatic chlorinators were installed to replace the existing manual type. Each of these technical advances afforded some improvement in the control of the taste and odor problem by effecting improvement in the maintenance of residuals, but as the city continued to grow, it became increasingly difficult to provide satisfactory water to the surge point areas and to those areas supplied by dead-end lines.

Finally, in February 1941, after these areas had continued to develop stagnant and sulfurous odors and black discolorations, the Sanitation Section, in co-operation with technicians of the Wallace & Tiernan Co., Inc., under the leadership of W. J. O'Connell Jr., made a complete survey of the Houston taste and odor problem. This survey revealed that the taste and odors were caused by organic growths, consisting of sheathed, threadlike organisms containing large amounts of ferrous material. O'Connell suggested the general classification of "crenoform" for this type of bio-fouling, describing the growths as follows:*

* O'Connell, W. J., Jr. Characteristics of Microbiological Deposits in Water Circuits. Refiner & Nat. Gas. Mfr. (June 1941) p. 111.

"The waters in the area do not contain any sulfate, but appear to be contaminated by the diffusion of hydrocarbons similar to mercaptans. When this water is discharged into the distribution system, it appears that the sulfur-containing hydrocarbons are assimilated by micro-organisms, with the ultimate production of hydrogen sulfide in a water supply containing an infinitesimal quantity of sulfur compounds. It appears that the organisms assimilate sulfur in their structures and that, following their death, certain complex proteins containing sulfur are made available as food for the remaining bacteria and other fungi—the result of this process being the deposition of a black sludge in the pipelines that has a characteristic odor noted in the refining of sour crudes. Hydrogen sulfide is in solution in the water in the region of the sludge deposition."

Inspection of well pump columns, well pumps and check valves of the municipal wells and numerous private wells revealed that the crenoform was originating in those wells that had screen settings in sand strata above 1,000 ft. The pump columns of many of these wells had organic deposits $\frac{3}{4}$ in. in thickness, and in some wells it was frequently necessary to replace parts of the deep well turbine pumps because of corrosion. These conditions first became apparent in 1939, at which time a sharp decline of the static level of the wells occurred due to the increased, concentrated industrial pumpage in the Houston area. In addition to severe bio-fouling of the storage reservoirs these growths were fouling the hydraulic-actuated equipment in the plants, making necessary frequent cleaning and replacement of parts due to corrosion.

The chloramination treatment practiced at that time consisted of applying an approximate chlorine dosage of 8 lb. per mil.gal. to the booster pump suction, followed a few seconds later by an ammonia dosage of from 1 to 2 lb. per mil.gal. This treatment yielded a chloramine residual at the plant tap of 0.7 ppm., and showed varying degrees of persistency of residual in the distribution system; but it was evident that this treatment was insufficient to control the crenoform, since, even in the presence of the maximum residual, the growths continued to foul and corrode the equipment in the plants.

Development of a Break-Point Treatment

A complete correlation of all the data obtained in the survey revealed that the crenoform could be controlled by maintaining a chlorine residual in excess of 1 ppm. for a contact period in excess of one hour, but at the chlorine dosages necessary for this control, the water developed chlorinous tastes and odors. No natural break-point was found in the Houston water.

The problem, then, was to develop some method whereby the tastes and odors developed by the increased chlorine dosage could be destroyed.

Such a method was developed after extensive laboratory work, being called "Ammonia-Induced Break-Point Chlorination"* because of the typical break-point curve induced when a given concentration of ammonia is applied to samples containing increasing concentrations of chlorine. After compensating for the low immediate chlorine demand of the Houston water, the ratio of ammonia as nitrogen to chlorine necessary to induce this break-point corresponds to the theoretical ratio of 1 to 7.6 obtained from the equation: $2NH_3 + 3\ Cl_2 \rightarrow N_2 + 6HCl$. This equation has been further substantiated by determinations of the ammonia content using the distillation and Nesslerization method. These determinations show the presence of ammonia at a ratio of ammonia, as nitrogen, to chlorine of 1 to 5.1, but at the ratio of 1 to 7.6 the ammonia content is zero.

The practical application of the method, then, is essentially the utilization of ammonia as a de-chlorinating agent. A chlorine residual sufficiently high to control the crenoform is maintained in the storage reservoir. Based on this residual, a calculated ammonia dosage is applied to booster pump suction and a sterile odorless and tasteless water, with an easily controlled and highly persistent free chlorine residual of any desired value, is pumped into the distribution system.

Results of the New Method

During the past year, this treatment has been initiated at all six water plants. Chlorine residuals in excess of 1 ppm. are being maintained in all storage reservoirs. The crenoform growths have been entirely eliminated in the plants.

The change in treatment has had an enormous effect upon the distribution system. When the method was employed at the first plant, a free chlorine residual was carried almost immediately throughout the entire distribution system supplied by that plant; but this effect was accompanied by violent chlorine by-product tastes and odors and discoloration. As soon as the area was flushed thoroughly, however, the water in the area was freed of all odor, taste and discoloration. The immediate effects were due apparently to the reaction of the free chlorine residual upon the crenoform existing in the mains.

The rapid change-over in treatment naturally gave rise to numerous consumer complaints, so it has been found advantageous at first to adjust the ammonia so that the resulting residual is slightly on the chloramine or left side of the break-point, or is actually zero. The ammonia dosage then is gradually decreased until the desired free chlorine residual is obtained. In this way the effect of the free chlorine residual upon the dis-

* Harvill, Clyde R., Morgan, J. H., and Mauzy, H. L. Practical Application of Ammonia-Induced Break-Point Chlorination. Jour. A.W.W.A., **34**: 275 (1942).

tribution system, with the resulting chlorophenol tastes and odors, is minimized. At one of the plants the change-over has taken approximately eight months due to the severe bio-fouling in the portion of the system supplied by the plant.

The treatment at the several plants now consists of adding a chlorine dosage of from 2 to 3 ppm. to the well discharge lines to the storage reservoirs. This dosage maintains a chlorine residual of from 1.3 to 1.7 ppm., in the reservoirs, depending upon the retention time of the water. Based upon this residual, an ammonia dosage of 0.5 to 1.5 lb. per mil.gal. is applied to the booster pump suction, yielding free chlorine residuals of 0.3 to 0.8 ppm. in the distribution system.

An examination of the entire distribution system a few months ago, in which the water in over 1,000 fire hydrants was tested for chlorine residual and taste and odor, demonstrated the effectiveness of the new method. Even though treatment has not been entirely stabilized at all the plants, the surge-point areas and the areas supplied by dead-end lines show definite improvement and, in many instances, are carrying a chlorine residual.

The purpose of the maintenance of a chlorine residual in the Houston distribution system has been primarily that of taste and odor control. At no time has it been considered a substitute for an active cross-connection location and elimination program, nor has it been utilized to cover up any other sanitary defect. It is felt, however, that, especially during the present time, this maintenance of a chlorine residual, not only in the distribution system but also in the storage reservoirs, has offered added protection to the consumers.

Boonville, Mo.—Major C. Hagar

PRELIMINARY to discussing the maintenance of chlorine residual in the Boonville, Mo., distribution system a brief introduction to its particular problem is necessary. Boonville has obtained its water supply from the Missouri River since 1888, but, as in many communities, the treatment equipment and processes have not always been kept up to date. When, in 1936, the old facilities proved inadequate, construction of a new $1\frac{1}{2}$-mgd. treatment plant was begun, and in June 1937, the new plant was placed in operation. At the time operation started, the laboratory was not yet completed, so, although chemical analyses were started at that time, bacteriological equipment was not installed until six months later.

With the beginning of bacteriological testing, at this later date, some particularly interesting facts were discovered. First, it was found that the 0.3 to 0.4 ppm. chlorine residual maintained in the clearwell after

12 hr. contact was leaving a high total bacterial count on nutrient agar, the counts ranging from 17 to 85 per ml. Also, a rather high percentage of presumptive lactose tubes were showing gas, in some months reaching as high as 35 per cent. These 48-hr. presumptive gas formers, however, would not confirm as coliform organisms.

At this same time it was found that both the filter influent and effluent carried high total bacteria counts, the effluent ranging as high as 350 per ml. and the influent even higher. The 10-ml. filter effluent samples would often complete five out of five as coliform organisms, and 1-ml. effluent samples have completed four out of five.

Experimentation With Treatment Procedure

Treatment at this time consisted of three to four days pre-sedimentation, addition of ammonia sulfate solution as the water entered the treatment plant, followed by addition of the coagulation and softening chemicals. To the water in the flash mixers, 1.5 to 2.0 ppm. chlorine was added as a pre-chlorination dose. Then after 4 hr. of mechanical mixing, sedimentation and recarbonation, the water entered the filters. Post-chlorination was effected by addition of chlorine to the filter effluent to maintain a clearwell residual of 0.3 to 0.4 ppm. after 12 to 24 hr. contact.

Upon taking samples from the distribution system, it was found that only the trunk mains had a chlorine residual, the dead ends and small mains showing none. Also, the total bacteria counts on nutrient agar remained high, as did the 48-hr. presumptive lactose gas formers.

Such a situation was not entirely satisfactory, so the treatment procedure was changed to include straight pre-chlorination and post-ammoniation, with a good mix of the ammonia sulfate solution before adding the post-chlorination dose. With this arrangement the residual was built up to 0.5 to 0.7 ppm. chloramines in the clearwell. Any higher residual in the clearwell resulted in a chlorine taste.

Experimenting further, the pre-chlorination dosage was increased from about 2.5 to 5.0 ppm., giving a higher residual—0.6–0.8 ppm.—on the filters. It was expected that taste complaints would surely result, but, since the high filter influent residual eliminated the coliform organisms in the filters, it was felt that the safety obtained warranted acceptance of this disadvantage. In the treatment, ammonia sulfate feed was kept the same, but the post-chlorination dose was reduced.

In determining the results of this treatment, it was found that the chloramine residual in the clearwell had increased to 1.0 ppm. after 24-hr. contact, but that the chlorine taste had disappeared. These findings were so unexpected as to be unbelievable, but when checks, including starch iodide tests, were made, the results were indicated to be reasonably correct.

New Sampling Procedure

Up to the time of these experiments, bacteriological samples had been taken regularly from the clearwell and from various points in the plant, but samples from the distribution system were taken at random, both as to time and place. In September 1939, therefore, it was decided to institute a regular distribution system sampling program to obtain a better picture of the product after it left the treatment plant.

The Boonville distribution system is composed of approximately twenty miles of cast-iron water mains ranging in size from 4 to 16 in. in diameter. Some of this pipe has been in the ground as long as 55 yr.; some, only a few years. The system is well constructed, with a minimum of dead ends; but, as in all systems that have just grown, there are some dead ends which cannot be made into circulating mains except at great expense. In an effort to make the best of the situation a survey to determine what was happening in the dead ends was initiated, with the thought of finding some remedy for the conditions there.

A sampling map was made showing all dead ends and all public gathering places, such as schools, restaurants, hotels and public buildings. A list of these locations was then made, grouping widely separated places into units of three, so that by systematically taking three samples a day a representative picture of the entire system would be obtained. At present there are sixty sampling points, each being covered every twenty days.

Each morning it is the duty of one of the two chemist-operators to collect the three samples scheduled for that day. If there has been a complaint of any kind or if something unusual has developed in the treatment process extra samples are taken as needed. Each sample is taken in two bottles. A 500-ml. bottle is used for the chemical sample and a 100-ml. sterilized bottle, for the bacteriological sample. The chemical samples are analyzed for turbidity, color, taste, odor, pH, alkalinity, total hardness and chlorine residual. About every sixth sample is set in a calcium carbonate saturation as a stability test. Complete permanent records are made of each sample.

Analysis of Samples

In the analysis of these samples a number of interesting facts have been discovered. Water that was thought stable at the treatment plant was found to be unstable in the dead ends. Water that left the clearwell with a very low bacteria count reached the dead ends with a much higher count. Also water that gave no presumptive gas in lactose broth after treatment, upon reaching the dead ends sometimes gave 48-hr. presumptive gas in four out of five 10-ml. tubes. It was noted that even with 0.7 ppm. chloramine residual leaving the clearwell most dead ends would show no residual.

At about the time the sampling system was initiated, the pre-chlorination dosage was doubled and, as mentioned before, the taste and odor noted with 0.7 ppm. residual chloramines in the clearwell disappeared when the residual reached 1.0 ppm. Further trials showed that residuals of 1.2 to 1.4 ppm. gave no taste or odor. In other words, super-chlorination had been practiced unknowingly. Later experimental work has shown that, by chance, the average optimum dosage point had been used.

When the 1.0-ppm. chloramine residual was established in the clearwell, a systematic flushing of dead ends was undertaken. After a few weekly flushings, chloramine residuals began to appear at the dead ends after they had stood dormant for a week. As the work progressed 0.1- to 0.3-ppm. residuals could be found at all dead ends sixty days after flushing.

Effect of Chloramine Residual

With the chloramine residuals came a reduction in the total bacteria count and a great decrease in the 48-hr. presumptive lactose broth gas formers, a condition which has continued. The total bacteria count on dead ends has been reduced, from an average of 18 to an average of 3 per ml. The percentage of presumptive gas formers has been reduced from 20.6 per cent to 6.2 per cent since chloramine residuals have been maintained throughout the distribution system.

The great majority of presumptive gas formers now occur in the central part of the system instead of in the dead ends. This indicates that the gas-forming organisms are hard to kill, especially with the slower acting chloramine residuals. In the 17,415 10-ml. tubes set since the high residual has been used, however, only five have completed as positive for coliform organisms. These tubes all came from one sample, so that it was possible to trace the difficulty directly to local contamination on a customer's premises. In this way, the contamination was arrested in the residential piping system before it reached the main.

It has been noted that during each month in which a larger number of 48-hr. presumptive gas formers than usual are found, the rainfall has been heavy on the Missouri River watershed above Boonville. This is true for both the warm and cold months. The variation in river stage shows little effect, but the rainfall on the watershed gives a direct reaction as to the number of presumptive gas formers found in the finished water.

It has, thus, been found that a high chloramine residual in the clearwell, carrying through the distribution system with at least 0.1 ppm. residual at the extreme dead ends has made possible a better quality water. This is not however a cure-all, because gas-forming organisms are still present in the water. A constant sampling of the distribution system is necessary to ascertain that they are not harmful organisms. Also, close control of the

chlorine-ammonia process must be practiced at all times to keep taste and odor conditions out of the water when a 1.2- to 1.4-ppm. chloramine residual is maintained after 24-hr. contact. With such close control, consumer taste complaints can be reduced to zero.

Although no water works operator should ever be satisfied with the quality of water that he is producing it is very satisfying to know that, in every water line, large and small, in his system, there are guards waiting to "take a pot shot" at any bacteria that dares to show its head. With the present-day methods of treatment only chlorine or chloramine residuals can act as such guards.

Wheeling, W.Va.—Arthur R. Todd

THE only way to make an unpalatable water palatable and an unsafe water safe (even to the extent of providing against the danger of bacterial contamination of the water by enemy agents during wartime) and to keep it so throughout the distribution system, is completely to satisfy that particular water. By satisfying it is not meant marginal chlorination, super-chlorination or break-point chlorination. What is meant is to add enough chlorine to oxidize and destroy the organic matter present and to yield a remainder of from 8 to 25 lb. per mil.gal. to go out through the distribution system.

If such a practice is followed, it will be found that there will be no change in the chlorine residual, even if the water passes through clean open masonry reservoirs exposed to sunlight. In fact an open bottle of such "city water" can be exposed to sunlight for three weeks before all the chlorine is changed to hydrochloric acid.

In Wheeling, W.Va., residuals going out into the distribution system range from 4 to 25 lb. per mil.gal., i.e., from $\frac{1}{2}$ to $2\frac{1}{2}$ ppm. Customers do not object to $2\frac{1}{2}$ ppm. but seem to notice residuals above that, although water with 7 to 8 ppm. is tasteless in the sedimentation basins during the process of treatment.

When chlorine combines with organic material, hydrochloric acid is one of the by-products. The amount of the acid produced depends on the number of hydrogen atoms displaced by chlorine in the compound upon which it is acting. For example, methane gas (CH_4) when acted upon by chlorine is changed to CCl_4 (carbon tetrachloride) + 4 HCl; and phenol + Cl_2 in an acid solution produces C_6Cl_5OH, which is insoluble in water and settles out. In an alkaline solution, the compound formed is C_6H_4OHCl, which gives the medicated taste produced when phenol-bearing waters are treated with small amounts of chlorine. This explains the fact that large

quantities of phenol, creosol or napthalene can be successfully handled by this process.

If it is desired to carry real residuals of 1 or 2 ppm. of chlorine, that too can be done and by a comparatively simple process. To accomplish it, sufficient chlorine should be added to raw water so that after 30 min. contact there will still remain from 32 to 56 lb. per mil.gal. chlorine, depending on the amount of phenol or napthalene present. The usual purification process can then be followed. Once the process has been started it virtually takes care of itself. If taste is noticed at the sampling point, the dose of chlorine should merely be increased.

At Wheeling, the average summer chlorine dose is 40 lb. per mil.gal., the winter dose, 78 lb. per mil.gal. The maximum feed was 113 lb. per mil.gal.

At Weirton, W.Va., which is also on the Ohio River, thirty miles north of Wheeling and about sixty miles by river from Pittsburgh, amounts as great as 238 lb. per mil.gal. were required last January. Incidentally, this plant, which is practically surrounded by coke ovens, is producing a very palatable water, whereas before the process was initiated almost every restaurant in town advertised that it was serving bottled water.

The Value of Sodium Hexametaphosphate in the Control of Difficulties Due to Corrosion in Water Systems

Committee Report

THE Committee on Water Conditioning Methods to Inhibit Corrosion has undertaken a special investigation of the use of sodium hexametaphosphate in the control of difficulties due to corrosion. This investigation was requested by the Association because of the increasing use of metaphosphate and because there is considerable difference of opinion as to the merits of the treatment.

The work was carried on by classifying the subject into various subtopics and assigning the responsibility for each topic to an individual member of the committee, whose name appears as a part of the heading of the following sections of this report. Those members who were unable to accept responsibility for a topic have, nonetheless, contributed their share by furnishing information and guidance to the chairman and to those engaged in preparation of the various sections. As advisory members of the committee, Owen Rice, E. H. Thwaits, Carter S. Cole and R. L. Ziegfeld have been of great value.

The terminology used in the literature on corrosion is greatly in need of clarification and definition, and the committee feels that it would be profitable for the Association to develop a standard glossary of the terms used. In this report, an effort has been made to restrict the term *corrosion* to the removal of metal from an exposed surface regardless of its subsequent fate. Where the metal removed becomes encrusted on the pipe as an insoluble oxide or other compound, the terms *tuberculation* or *incrustation* are employed. *Red water* refers to the presence of suspended iron compounds in the water, and may be due to corrosion or to the fact that the water itself contains iron. *Pitting* refers to the localization of corrosion in small, well-defined areas of penetration.

A committee report presented in tentative form on June 24, 1942, at the Chicago Conference by E. W. Moore, Chairman of the A.W.W.A. Committee on Water Conditioning Methods to Inhibit Corrosion, and Associate Professor of Sanitary Chemistry, Harvard Graduate School of Engineering; revised and unanimously approved by the Committee on October 27, 1942.

Brief History of the Use of Glassy Phosphates for the Control of Difficulties Due to Corrosion—*Owen Rice

As is evident from the literature, one of the first applications of the discovery of Rosenstein (1) that supersaturated solutions of calcium carbonate could be stabilized by the addition of very small amounts of any molecularly dehydrated phosphate was its use for preventing after-precipitation in lime-soda softened water. It was thought that the high pH value which could be maintained, without trouble from scale formation, in water stabilized by such a phosphate would probably eliminate any corrosion. Consequently, when the use of Calgon† was started at Columbus, Ohio, as well as at several other plants, recarbonation was reduced or eliminated entirely in order to increase the pH and the normal carbonate content of the finished water. The red-water conditions existing in the hot-water tanks were much improved by this treatment. Subsequently, good results were obtained at other plants where the use of the phosphate was not accompanied by an increase in pH, since recarbonation had never been used, and, finally, at Dallas, Tex., where the corrosion problem had been pronounced and where the pH was actually *lowered* when the use of phosphate was started. This indicated that the presence of the phosphate was largely responsible for the reduction in red water in the hot-water tanks which had obtained in all these plants.

At about the same time, it was thought likely that the control of corrosion in some naturally soft waters might be improved through the use of increased quantities of lime or other alkali, this being made feasible by the stabilizing action of the phosphate on calcium carbonate. This was, for instance, the original basis for the use of the phosphate at Hempstead, L.I. There, lime had been used for several years with fairly good results but some difficulty with red water was still being experienced. Upon the addition of the phosphate, the lime was increased and the pH of the water, which had formerly been 8.6 at the plant and 7.5 at the extremities of the system, was raised to 9.4 at the plant and 9.2 at the dead ends. An almost immediate elimination of red water complaints and a great improvement in the conditions existing in the distribution system resulted, as shown by the regular flushing of hydrants. Upon the recommendation of Calgon, Inc., manufacturers of the phosphate, the quantity of lime used was then decreased and it was found that equally good results in controlling red water were obtained at a pH of 7.0. The neighboring town of Garden City, L.I., obtained satisfactory results at a pH of 6.2 (2) and Fairhaven, Mass., did likewise at a pH of only 5.4 (3).

* Calgon, Inc., Pittsburgh, Pa.

† A phosphate glass containing 33–34% Na_2O and 67–66 P_2O_5; may be considered to be a mixture of sodium meta- and pyrophosphates.

Prior to the use of the phosphate at Hempstead and Columbus, results had been reported from several large oil refineries in Texas, where phosphate treatment had been started to alleviate scale formation in a water which was brackish, hot and saturated with oxygen. Reports of removal of old scale and complete scale prevention on newly cleaned surfaces were received with trepidation, for reports of severe corrosion were anticipated next. These never materialized and inspection showed that the iron surfaces were covered with a dense, hard, dark coating of oxide which seemed to be providing protection.

Before and during the time these observations were being made in the field, work was in progress at the manufacturer's laboratories. The first experiments performed led the staff of the company to the opinion that the use of the glassy phosphates alone had a much greater effect in decreasing corrosion than did the elevation of the pH and that the addition of alkali seemed to increase the tendency to form tubercles. It was also concluded that the concentration alone was no more important than the volume and velocity of flow. These results together with the earlier observations on the adsorption of metaphosphate on metallic surfaces (4) led to the belief that an adsorbed film of phosphate was responsible for the reduction in corrosion.

During the entire development, the best results were always obtained in the field and especially in the plants handling the largest volume of water. The failures reported both in laboratory tests and in the field are believed to have occurred because the flow of water has been very low in proportion to the phosphate feed used.

Theory of the Action of Hexametaphosphate—*E. W. Moore*

The soluble meta- and pyrophosphates possess certain properties which are unusual. The complex phosphate ions produced by these substances are capable of taking up such ions as calcium, iron and others which might be precipitated under the conditions prevailing in the water, and of holding them in the form of a soluble complex phosphate ion. This property has been discussed mainly by those interested in the use of complex phosphates in the textile industry, but it may account in part for their tendency to hold in solution such readily precipitated substances as iron. It has been shown that the application of the complex phosphates to iron- and manganese-bearing waters will prevent the deposition of these substances even in the presence of dissolved oxygen. One theory advanced to explain these phenomena is that these soluble complex phosphate ions contain one or more un-ionized sodium atoms which may be replaced by other metals, thus removing them from solution.

It is probable, however, that complex-formation is significant only when the concentration of meta- or pyrophosphate employed is relatively high as in the textile industry. A more important property, in relation to the use of metaphosphates in water treatment, is their ability to form films on the surfaces of metals and on the fine crystals which form as the first step in the precipitation of an insoluble substance. The films formed on metals seem to protect them from further attack, while those on the fine crystals are considered to prevent the aggregation of these crystals to form a precipitate. These films have been discussed in the literature, but their chemical composition has not been determined. It is believed that they are made up of phosphates of the metals involved, since most of these are relatively insoluble. It is of interest to note that in the application of metaphosphates for the mitigation of tuberculation and red water in water supply systems, the important factors seem to be the rates of flow and the amount of phosphate added per unit of internal area of the piping in the system.

Survey of Results of Metaphosphate Treatment—***E. H. Thwaits****

Summary

Number of questionnaires sent:	
Cities	301
Buildings	13
Total	314
Returns:	
Cities—Complete	168
Cities—Incomplete or no data	52
Buildings	7
Total	227
Percentage of questionnaires sent (227/314)	72

Replies by Cities

	No.	*Per Cent*
Positive elimination of difficulties	68	41
Partial to substantial elimination of difficulties	57	34
Total reporting benefit	125	75

* Engr., American Iron & Steel Inst., New York

Replies by Cities—Continued

	No.	*Per Cent*
Too soon to know	27	16
No opinion or answer	7	4
No elimination of difficulties	9	5
Check totals	168	100
Eliminated or reduced consumer complaints	158	94
Did not reduce consumer complaints	10	6
Check totals	168	100

Replies by Buildings

	No.
Positive correction of difficulties	4
Partial to substantial correction of difficulties	2
Total reporting benefit	6
No correction of difficulties	1
Check total	7

Analysis of Reasons for Using Metaphosphate—Cities

	No.
Corrosion	28
Corrosion and red water	17
Corrosion and scale	7
Corrosion and calcium and carbonate stability	6
Red water	38
Red water and scale	11
Red water and calcium carbonate stability	4
Control of iron content	10
Control of pH value	2
Control of scale	21
Calcium carbonate stability	20
Not stated	4
Check total	168

Application of Metaphosphate to Ferrous Metal Piping Systems—*H. P. Stockwell Jr.**

Following the introduction of metaphosphate treatment of lime-soda softened waters to prevent after-precipitation of calcium carbonate, it became evident that the character of the treated water had been greatly improved in regard to red-water conditions and tuberculation of mains.

Metallic iron dissolves in water and the dissolved iron reacts with any available oxygen to form hydrous ferric oxide which may be carried in suspension as red water or deposited on the pipe walls. High pH values favor rapid oxidation and the product may then adhere strongly to the pipe wall, thus forming a protective coating. This coating may, however, contain imperfections where corrosion will continue, resulting in pit formation and tuberculation. The principal economic loss resulting from this tuberculation follows from increased frictional resistance to flow, often reflected in higher pumping costs.

All practical corrective treatment methods depend upon the interposition of an impervious protective film between the water and the pipe wall. Metaphosphate is now being used in many plants for the prevention of red water due to corrosion and the results have been satisfactory in nearly every case. The ability of this material to prevent precipitation of dissolved iron, thus eliminating staining effects, and to keep the inner pipe wall free from excessive deposit is certain to create a favorable reaction on the part of both householder and operator. In many cases the benefit credited to metaphosphate is based on qualitative observations, but some data, both experimental and practical, involving iron determinations and loss of head tests are also available.

Corrosion Tests

Red water, porcelain staining, leakage or blockage in household water systems and tuberculation of mains are all functions of "total corrosion" of iron in the water supply concerned. The ultimate goal of protective treatment development is to reduce "total corrosion" to negligible proportions. The so-called steel-wool test is sometimes used to demonstrate, qualitatively, the benefit of metaphosphate treatment in this respect. Care should be taken in interpreting this simple test, inasmuch as the fact that treatment effectively prevents precipitation of dissolved iron and non-appearance of rust in the filter does not necessarily indicate absence of corrosion, although it does demonstrate other desirable effects of the treatment.

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* Chem. Engr., Ottawa, Ont., Water Purif. Plant

Corrosion tests carried out at Ottawa indicated that, on black steel and wrought-iron specimens immersed in filtered water, 2 ppm. metaphosphate is not quite as effective as lime treatment, although best results were obtained using both treatments together. Copper-bearing steel reacted in exactly the opposite manner. This filtered water had a pH of 5.7 to 6.3 and contained 18 to 23 ppm. of sulfate introduced by the alum used to coagulate color in the raw water. The effect of metaphosphate on the soft colored raw water was to increase aggressiveness, possibly by interfering with some protection afforded by the organic content. Table 1 shows the mean penetration of corrosion, expressed in inches $\times 10^{-4}$, for these test pieces, which were short lengths of $\frac{3}{4}$-in. diameter pipe, exposed for a period of 90 days.

TABLE 1

Effect of Metaphosphate on Mean Penetration of Corrosion in Various Metals

WATER	MEAN PENETRATION OF CORROSION, IN. × 10					
	Black Steel		Wrought Iron		Copper-Bearing Steel	
	No Metaphosphate	2 ppm. Metaphosphate	No Metaphosphate	2 ppm. Metaphosphate	No Metaphosphate	2 ppm. Metaphosphate
Raw (pH 6.9–7.3)	2.18	2.60	2.46	2.81	1.78	2.89
Filter Effluent (pH 5.7–6.3)	4.91	5.29	6.09	6.05	5.32	3.50
Filter Effluent plus Lime (pH 7.1–7.3)	4.72	5.11	7.94	5.33	4.36	3.97
Tap (0.80 gpg. Lime) (pH 8.3–8.7)	4.87	3.87	5.91	4.21	4.91	4.13

In corrosion studies involving the determination of total dissolved and suspended iron in water withdrawn from any ferrous metal piping system full allowance must be made for the fact that metaphosphate diminishes the intensity of color produced by thiocyanate. To avoid any error the sample should be boiled long enough to effect reversion of all metaphosphate to the ortho- form, or, alternatively, the use of ortho-phenanthroline reagent with hydroxylamine as a reducing agent is strongly recommended (5, 6).

The effect of metaphosphate treatment in reducing the iron content of corrosive filter effluent at Ottawa, after passing through a 9-ft. length of new $\frac{3}{4}$-in. wrought-iron pipe at a rate allowing 1 hr. 40 min. of retention in the pipe, is shown in Fig. 1. The water samples as used had a pH of 6.0 and an original iron content of 0.03 ppm. Flushing of the pipeline at intervals disclosed that rust in the pipe is more easily disturbed when

metaphosphate is used. In contrast to this, tests carried out at San Francisco, using metaphosphate in a water of pH 7.6 and alkalinity 75 ppm. show somewhat different results. Specimens of low-carbon steel were hung in a tank containing water being recirculated through a fountain. With untreated water a soft loosely adhering rust was formed and red water resulted. With lime treatment at pH 8.7 a harder scale was formed and with metaphosphate (1 ppm.) a still somewhat harder scale was deposited on the test pieces, both treatments eliminating the red water condition.

Successful Applications of Metaphosphate Treatment

E. Mood of the New Haven Water Co. advises that the feeding of metaphosphate at a rate of 0.33 ppm. to the Bethany supply, New Haven, Conn., practically stopped iron pick-up in a 45-ft. length of $\frac{3}{4}$-in. black-

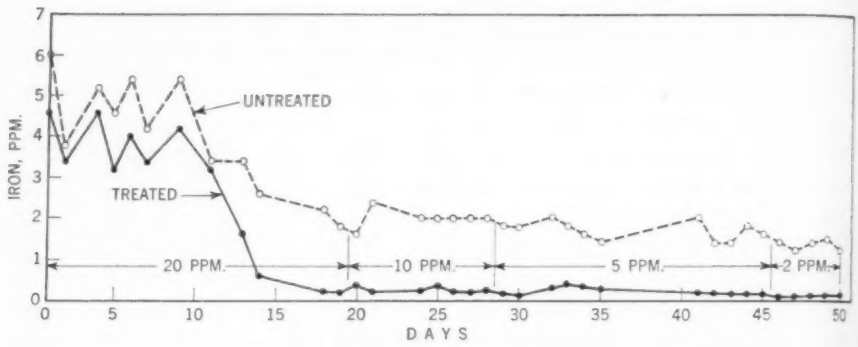


FIG. 1. Effect of Metaphosphate Treatment on Iron Content of Water Passing Through New Wrought-Iron Pipe

iron pipe, the rate of flow being equivalent to a 3-min. retention in the pipe. The water supply is quite soft, mildly aggressive, and has a pH of 6.5 to 6.8 and an iron content averaging 0.05 ppm. Application of metaphosphate at a rate of 0.11 ppm. under the same conditions resulted in only partial reduction of iron pick-up. The experimental equipment consisted of three 45-ft. lengths of pipe connected to a constant level box. Untreated water was allowed to flow through the three lines until corrosion rates had become more or less constant; metaphosphate at the above rates was then applied to two of the pipelines, respectively, the third continuing without treatment. Iron determinations made at intervals showed that the iron content of the untreated water increased 8-fold to an average of 0.41 ppm. Treatment with 0.11 ppm. metaphosphate held the iron content to 0.11 ppm. average or twice that of the raw supply; treatment with 0.33 ppm. prevented any apparent increase in iron content. Soft marble

slabs placed under the effluents for 72-hr. periods demonstrated the absence of staining effect with this treatment.

Gidley and Weston (3) have described the application of this treatment to a well water supply containing 30 ppm. carbon dioxide and of low pH value, 5.6. While this untreated water is said to be less corrosive to most metals than would be expected, the action on yellow brass is quite severe. Experiments showed that no great benefit would derive from the use of lime or soda ash. Following experiments of the steel wool type, 1 ppm. of metaphosphate was applied to the supply. Purgative action was not severe except at dead ends, and there it gradually disappeared. In a private communication Weston cites results of iron determinations made since publication of the above article which indicate that the iron content of this water at all sampling points, including dead ends, remains at 0.10 ppm. or less.

TABLE 2

Average Results of Iron Determinations After Metaphosphate Treatment at Wakefield, R.I.

SAMPLING POINT	SEPT.–DEC. 1941		JAN.–MAR. 1942	
	Iron, ppm.	pH	Iron, ppm.	pH
Filter effluent	0.08	6.7	0.04	5.5
Water company Office—Narragansett	0.16	6.6	0.59	5.9
Dead end—Peace Dale	1.18	6.6	1.93	5.8
Dead end—Narragansett	0.58	7.0	0.48	6.6

In the same communication, Weston comments on the use of metaphosphate at Wakefield, R.I., where he considers it has also been a success. The raw water there bears considerable color, varying from 25 to 220 ppm. It is removed by coagulation and pressure filtration. The untreated effluent was found to be quite corrosive and initially lime was used as a corrective reagent. The dosage required was large and there was considerable undesirable accumulation of a chalky nature in the mains. Early in 1941, metaphosphate treatment was introduced in conjunction with the lime treatment, the latter being gradually reduced and finally discontinued. The initial dosage of metaphosphate was limited to 4 ppm. for fear of purgative effect on deposits in the mains and was later reduced to 2 ppm. The change in treatment is said to have improved conditions in the distribution system greatly, although it has been attended by some dislodgment of old accumulations. Conditions in some dead ends are not the best, but are considered to be improving gradually. Average results of iron determinations are listed in Table 2. These values seem high in some in-

stances and would suggest that some cleaning action is still taking place in the mains.

The Etobicoke Township plant at Islington, Ont., is, to date, the only plant in Canada using metaphosphate. The supply is well water treated in zeolite softeners to reduce hardness to 80 ppm. and iron to 0.5 ppm. This iron content together with an additional amount acquired in the distribution system formerly resulted in much red water, and there was a great deal of tuberculation in the mains. Treatment with caustic soda and silicate of soda resulted in only slight improvement. Treatment was changed to metaphosphate in November 1941, using 2 ppm. and later reducing to slightly over 1 ppm. As a result, red water has been entirely eliminated, the tap water appearing crystal clear. While, in this case, metaphosphate acts in part to prevent precipitation of the iron normally

TABLE 3

Results of Flow Tests on Untreated and Metaphosphate-Treated Tap Water After 78 Days Run at Cincinnati, Ohio

	METAPHOSPHATE-TREATED	UNTREATED
Initial flow, *gpm*	3	3
Decrease in flow, *gpm*	0.31	1.54
Decrease in flow, %	10	51
Increase in loss of head, *in.*	37.25	78.13
Williams-Hazen *C* value at start	111	111
Williams-Hazen *C* value at end	65	27

present in the water, there is also a marked effect on the inner surface of the water mains. It was noted that sections of pipe formerly showing much tuberculation then presented an inner surface almost as good as that of new pipe, the deposit having been almost completely removed. F. McArthur, Township Engineer, who submitted this information to the committee, states that he is completely satisfied that this treatment has produced very marked improvement in the quality of the water supply.

Experiments on Tuberculation

Some very interesting experimental work has been carried out at various places to determine the effect of metaphosphate treatment on the tuberculation of pipe. Tuberculation is usually measured by the change in head loss developed as the resistance to flow increases. As already mentioned experiments carried out by Mood at New Haven on $\frac{3}{4}$-in. black-iron pipe showed that this treatment reduces but does not eliminate the loss of flow

coincident with tubercle formation. After 27 days, the rate of flow of untreated water had fallen off 41.7 per cent. When treated with 0.11 ppm. metaphosphate, the reduction was 19.3 per cent, and with 0.33 ppm., only 15.5 per cent.

C. Bahlman, Supervisor of Water Purification, Cincinnati, Ohio, has supplied details of an investigation carried out by Evans and Shuey in which tap water was allowed to flow under constant head at an initial rate of 3 gpm. through two 20-ft. lengths of $\frac{1}{2}$-in. black-iron pipe, 4 ppm. metaphosphate being applied to the water passing through one of these pipes. After 78 days' run, the results obtained were as shown in Table 3. From these results the investigators concluded that the metaphosphate treatment effectively retards the formation of friction-causing components in pipelines.

TABLE 4

Results of Head Loss Tests at San Francisco

LINE	TREATMENT	APPROX. pH	PERCENTAGE INCREASE IN HEAD LOSS
1	H_2SO_4 and metaphosphate	6.1	little or none
2	Metaphosphate	7.6	20
3	Lime and metaphosphate	9.0	90
4	Lime	9.0	120
5	Raw	7.7	130

In another private communication, H. C. Medbery, Chief Water Purification Engineer, San Francisco, described an experiment on head losses to determine the effect of various treatments on tuberculation. The results are submitted with the qualification that they be taken as indicating trends only, as the investigation is not yet completed. In this test tuberculation of five 50-ft. lengths of $\frac{3}{8}$-in. black-iron pipe was indicated by the head losses after three weeks' run with a set discharge of 1 gpm., the metaphosphate dosage used being 1 ppm. The results were as shown in Table 4.

The pipes were then cleaned and the test continued. At the end of three weeks, the trend was the same but the head-loss percentages were higher and the initial flow of 1 gpm. was reduced to $\frac{1}{2}$ gpm. in all lines by the end of seven weeks; and after eight weeks, the raw water flow was reduced to about $\frac{1}{4}$ gpm. The friction losses for these discharge rates after various time intervals were as shown in Table 5, indicating that, after three or four months of operation, the best results are obtained with

lime and lime plus metaphosphate, despite the initial high rate of tuberculation observed with these two forms of treatment.

A large-scale experiment has been carried out under the direction of G. D. Norcom and T. H. Wiggin on a main forming part of the distribution system of the Western New York Water Co. at Buffalo, N. Y. This main is cleaned annually so that information concerning the pipe coefficients was available. With the addition of 2 ppm. metaphosphate, the coefficient dropped from about 148 at the start, to 111 at the end of the test period. In similar tests, without metaphosphate, the final values of the coefficient were from 93 to 97. Tuberculation was not eliminated, but the tubercles

TABLE 5

Friction Loss on San Francisco Test Pipes at Various Intervals

LINE*	FRICTION LOSS, IN CM., AT:				
	9 weeks	13 weeks	17 weeks	21 weeks	29 weeks
1	49	52	99	135	153
2	50	96	121	135	144
3	65	63	66	73	74
4	84	83	84	82	81
5	66	87	122	158	170

* See Table 4 for description of different lines.

appeared to be smaller in size when metaphosphate was used. Other experiments indicated that lime treatment to the calcium carbonate saturation pH value also retards the reduction in coefficient.

The experience with metaphosphate to date indicates that this material merits consideration wherever corrosion problems are encountered. It has been proved that it tends to keep iron in solution in water, prevents iron staining and reduces tuberculation to a .considerable extent. In many cases iron pick-up in the distribution system is greatly reduced. There is need for more data concerning the loss of metal from iron pipe, as the information now available is so conflicting that some workers believe that metaphosphate alone will diminish the loss of metal, while others feel that metaphosphate alone will accelerate such loss.

Application of Metaphosphate to Non-Ferrous Systems— ***E. W. Moore***

Information at present available to the committee regarding the effect of metaphosphate on metals other than iron is conflicting. Frank E. Hale has furnished the writer with a description of experiments on the effect of metaphosphate-treated Catskill water (New York City) on brass and zinc. In these experiments, it was found that metaphosphate treatment slightly increased the rate of attack on both zinc and brass, particularly on the former.

A communication from Owen Rice to the writer includes the following instances of favorable action of metaphosphate on non-ferrous metals:

"*Copper*—We have had a report from A. H. Rogers at Garden City, L.I., that the addition of Calgon to their water has lessened the amount of staining of plumbing fixtures due to copper and brass, but this trouble has not been eliminated. We have had reports from two industrial plants, where Calgon was used, that such stains on drinking fountains and plumbing fixtures have been eliminated. We have had similar reports on two or three jobs where Micromet was used in individual household supplies.

"*Zinc*—Preliminary tests made by Dr. Hatch with zinc shot, using technique reported in our data on steel wool, indicated that hexametaphosphate decreased the corrosiveness of Pittsburgh tap water toward zinc approximately 75 per cent. Some qualitative tests made on both hot and cold water seem to corroborate these indications. In one extreme case of corrosion, the galvanizing was removed from hot water pipe in 30 days. The water was that of the Detroit city water supply, softened with zeolite. After installing sufficient Micromet to supply 2 ppm. to the water, similar test nipples have shown the zinc to be intact after ten months. In fact, there is no change in appearance between samples one month and ten months old, so that it appears the zinc may last indefinitely. Similar good results on zinc were obtained [with Calgon] on test nipples installed in the Warden Apartments Hotel, Fort Dodge, Iowa. This has been reported by Thwaits. So it would seem that at least in these cases, where the rate of corrosion of zinc was very rapid, both Calgon and Micromet have done an excellent job of protecting the galvanizing.

"*Brass and Bronze*—Excellent results have been obtained in protecting meters at Hubbard, Ohio, and Greenup, Ky. We have test meters removed from these systems after one year's use before and following the use of Calgon.

"*Aluminum*—Excellent results in protecting aluminum have been obtained in laboratory tests conducted by Dr. Hatch in tests made with Pittsburgh city water, especially at low pH values. I do not believe tests

have been made at higher pH values in the laboratory. However, we do have a report from the Municipal Water Plant at Fostoria, Ohio, that the aluminum valves in the high pressure pumping engines, which formerly had to be replaced every six months, have shown no further sign of attack since the use of Calgon was started some two years ago. In the paper by J. R. Akers and R. B. Mears of the Aluminum Research Laboratory entitled, "Cleaning Aluminum" (7), you will find further mention of the use of hexametaphosphate for protecting aluminum from corrosion."

A communication from H. P. Stockwell of the Ottawa Water Purification Plant describes experiments on copper and brass, using raw Ottawa River water (pH 6.9–7.3), filter effluent (pH 5.7–6.3), lime-treated filter effluent (pH 7.1–7.3), and city tap water (pH 8.3–8.7). In measuring corrosion in terms of penetration of test pieces, it was found that no measurable benefit was secured by the addition of 2 ppm. metaphosphate to any of the waters.

Where lead pipes and services are employed, interest centers on the amount of lead taken up by the water, rather than the other aspects of corrosion. This follows from the toxicity of the metal and from its intrinsic resistance to corrosion.

The information available on the effect of metaphosphate on the solution of lead is fairly consistent. Experiments published by Hatch (8), by E. W. Moore and F. E. Smith (9) and work by the water laboratories of the Massachusetts State Department of Health indicate that the solution of lead from lead wool and both new and used lead pipe is diminished by doses of metaphosphate such as are applied in practice. This is true for waters having pH values of 7.0 or lower, which dissolve considerable quantities of lead. For alkaline waters, with pH values above 8.0, all work except that of Hatch shows that metaphosphate slightly increases the lead pick-up. Since this increase tends to vanish as the treatment is continued, and since the amount of lead picked up by such alkaline waters is negligible in any case, however, it is generally agreed that there is no danger to public health in the use of metaphosphate in systems containing lead pipe, provided that the amount used remains within reason.

The water laboratories of the Massachusetts State Department of Health are also studying the effect of metaphosphate on the corrosion of copper and brass. The short term results indicate little protective effect by metaphosphate; in fact, at a pH value of 6.1, more corrosion has been observed in the metaphosphate-treated water than in the untreated water. These results are not considered as final, however, and the experiments are being continued to see whether or not a protective action will be developed in time.

Use of Metaphosphate in Conjunction With Other Chemicals—*H. M. Olson**

Some years ago, when the phosphates were introduced as corrosion control chemicals, their possibilities made them welcome in the numerous plants where red-water troubles and corrosion accompanied existing treatment methods. In a great many plants, where stabilization was obtained by the addition of lime or some other chemical, however, the stabilized conditions could not be disturbed, so it was necessary to add the phosphate in conjunction with the chemicals already in use. In most cases different combinations of phosphates and lime or other chemicals were tried. Reports on the methods used and results obtained at some of these plants have been obtained from the superintendents or chemists in charge as reported here:

At Hempstead, L.I., water from deep wells produced corrosion troubles which were rectified in part by the application of lime to produce pH values of 9.0–9.3. Experiments with metaphosphate led to the use of 0.5 ppm. Calgon in conjunction with the lime. When the pH value was brought below the calcium carbonate stability point of 9.0–9.3, copper stains appeared on plumbing fixtures.

At Uniontown, Pa., the pH value is maintained above the calcium carbonate stability point with lime and 1 ppm. of Calgon is added to retard deposition of lime.

Little Rock, Ark., failed to correct red-water troubles entirely with lime at pH 9.2, and tried Calgon, beginning with 2 ppm. and dropping to 1 ppm. Red-water complaints were almost eliminated, and the pH value was lowered to 8.7–9.0. Local metaphosphate treatment (Micromet) was used to overcome red-water troubles persisting in some hot-water tanks.

Newport, R.I., used 1.5 ppm. Calgon plus lime to produce a pH value of 9.0, but has gradually lowered the pH value to 7.0 with good results.

Winchester, Mass., had tried lime, and then caustic soda and sodium silicate, without eliminating complaints. Calgon was then introduced and the other chemicals were gradually eliminated with good results.

At Freeport, L.I., lime alone was not satisfactory, but the addition of 0.25 ppm. Calgon along with the lime gave excellent results.

From the information received, it is apparent that lime and Calgon may be used successfully in the control of difficulties due to corrosion, and that the combination is to be recommended where either alone will not produce the desired results. For the best results, the pH value must be carefully controlled. Other chemicals have not been used to any great extent in conjunction with Calgon, and such combinations have usually been abandoned wherever tried.

* Advisory Maint. Engr., The Ohio Salt Co., Wadsworth, Ohio

Although not directly related to the corrosion problem, the use of metaphosphate to prevent the precipitation of iron or manganese already present in a water supply is of some interest as an indication of its probable action in preventing red water due to corrosion. It has been found that the application of 1 ppm. of Calgon for each 1 ppm. of ferrous iron and 3 ppm. for each 1 ppm. of manganous manganese will keep those metals in solution even though the water is subsequently aerated. This property of Calgon is already being taken advantage of in practice, to prevent iron precipitation in chlorinator trays, and even as a substitute for iron and manganese removal in certain water supplies.

Strong solutions of Calgon tend to attack metals; consequently, in feeder tanks, the pH of the strong Calgon solution must be kept above 9.0 by the addition of alkalies. About 10 per cent soda ash, or 3 per cent caustic soda or lime, based on the weight of Calgon, is necessary to accomplish this.

Disturbances Produced in Water Systems by Metaphosphates— ***John J. Quinn****

At present over 300 water supplies throughout the country are using metaphosphates. Only a few of these systems have experienced difficulties from sloughing through the use of this material.

The cities reporting disturbances are those in which water containing iron and manganese was fed to the distribution systems, so that a hydrous non-adherent deposit of iron and manganese dioxide was present in the mains. The metaphosphate apparently dispersed these deposits, an effect that is not obtained where iron oxide is present as the result of corrosion.

At Wilkinsburg, Pa., such removal of old deposits occurred, the disturbance being experienced after the plant had dropped the pH abruptly from above 9.0 to about 7.0.

Old deposits of manganese caused difficulties at Fairmont, W.Va., also when there was a sharp reduction in the pH by the elimination of the feed of alkali.

The experience at Fairhaven, Mass., as reported by Gidley and Weston (3) was an example of disturbance in a system carrying iron-bearing water. The disturbance was gradually eliminated by flushing, and the metaphosphate treatment has since been reported to be highly satisfactory.

Little Rock, Ark., was an exception to the fact that all the disturbances reported occurred in systems where deposits had been laid down from the water, as distinguished from deposits built up through corrosion of the mains. There also the pH value was lowered abruptly when metaphos-

* Chief Chemist, Knoxville, Tenn., Water Bureau

phate treatment was started. The trouble was eliminated by returning to the original pH value, and then gradually lowering it to the desired level.

It is significant that there have been very few reported instances of sloughing from distribution systems through the use of metaphosphate. Where removal of old deposits has occurred, they have not been serious except where there was also a rapid drop in the pH of the water going into the system. Rapid changes in pH value should therefore be avoided. Where there is dissolved iron present in the water it may be anticipated that sloughing of the old deposits will occur for a while, but, after a flushing program has been completed, there should be no further difficulties.

The only two indications that the use of metaphosphate caused an increase in bacterial counts were at Wilkinsburg, Pa., and in the laboratory at Cambridge, Ohio.

At Wilkinsburg, Pa., the increased bacterial count occurred along with the removal of old deposits after the pH had been dropped from 9.0 to 7.0. It is believed that the increased count of bacteria was caused by the dislodging of colonies that were imbedded in the old deposits, as it is understood there was no increase in bacterial counts on samples taken from a new asbestos-cement pipe line.

At Cambridge, Ohio, laboratory experiments at first seemed to indicate that metaphosphate caused increased bacterial counts. Later experiments indicated that the increase was not due to an increase in bacterial count, but to the dispersion of bacterial clumps that gave large numbers of colonies on the plates.

With only two instances reported of apparent increase in bacterial counts due to the application of metaphosphate to a water system, it may be safely stated that this material has no effect in increasing the growth of bacteria. However, Frank E. Hale has stated that it was necessary to add hypochlorite to the strong metaphosphate solution at Jamaica, L.I., in order to kill the *Esch. coli* found in the solution.

Instances of Failure of Metaphosphate Treatment—*E. W. Moore*

The committee has endeavored to find water-supply systems in which metaphosphates have been tried without beneficial results. Some of the instances which have come to the committee's attention are noted in the following paragraphs.

The only case reported in the literature which might be classed as a failure is the experience at Nitro, W.Va. There, red-water troubles were occurring in a recently cleaned main despite the maintenance of a pH value from 8.0 to 8.5 by means of lime treatment. Metaphosphate application was started in conjunction with the lime treatment, beginning at a dose of

10 ppm. and subsequently cutting to 5 ppm., then to 1 ppm. There was no decrease in the iron pick-up through the main. Then, the alkalinity of the filtered water suddenly dropped from 40 ppm. to less than 10 ppm., and on discontinuing metaphosphate treatment and raising the pH value to 9.0, the iron content of the effluent from the main decreased to 0.1 ppm. As the alkalinity of the filtered water again rose to 30 ppm., however the iron content of the effluent increased despite the high pH value of 9.0–9.2.

As was pointed out by Rice in his discussion of the case, there is a possibility that not enough metaphosphate was applied. In a private communication, the Nitro Water Superintendent has reported that, although metaphosphate had failed, in this instance, to do what was expected of it, it had been subsequently used after cleaning of mains in another plant under his control. The conditions under which it was applied were not such that the beneficial effect of metaphosphate could be accurately evaluated, but it was felt that some benefit had been obtained.

The writer has also received a confidential communication relating to a zeolite-softened supply which had been treated with 1 ppm. of metaphosphate over a considerable period of time without checking red-water troubles. The difficulty was corrected by eliminating metaphosphate and substituting lime treatment to a Langelier index of plus 0.2.

These few examples serve to show that treatment with metaphosphate does not always remedy difficulties due to corrosion. The reasons for failure of the treatment are not evident, but it is indicated that insufficient dosage may sometimes be responsible. The information available to the committee at present indicates that the number of recorded failures of metaphosphate treatment is small, considering the extensive adoption of this treatment in the last few years.

Temporary disturbances of distribution systems produced by the introduction of metaphosphate treatment are not considered as necessarily indicating failure of the treatment. These disturbances are discussed in another section of the report.

The Economics of Metaphosphate Treatment—***Marsden C. Smith****

It is quite difficult, if not impossible, to determine the economics of the treatment of public water supplies for the control of corrosion by metaphosphates. This is true even when no corrosion control has been used prior to the adoption of the metaphosphate treatment.

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* Chief Engr., Dept. of Public Utilities, Richmond, Va.

There are many reasons for this difficulty. Both the raw water quality and the results obtained vary so widely that cost comparisons lose much of

TABLE 6

Comparison of the Gross Cost of Corrosion Control Treatments

CITY	PUMPAGE MGD.	BEFORE—OTHER CONTROL		AFTER—METAPHOSPHATE		
		Chemical Used, ppm.	Cost Per Mil. Gal.	Chemical Used, ppm.	Cost Per Mil. Gal.	Increase Cost Per Mil. Gal.
Larchmont, N.Y.	1.0	20 Soda Ash	$1.66	1.6	$2.06	$0.40
Laurens, S.C.		4.3 Soda Ash	0.36	2.0	2.67	2.31
Little Rock, Ark.	11.0	12 lime	0.50	1.0 Lime 5.0	1.29 .21	1.00
New Castle Water Dist., Chappaqua, N.Y.	0.25	6 Lime	0.25	1.5	2.00	1.75
Roaring Creek Water Co., Shamokin, Pa.	5.0	12 Soda Ash	1.00	0.75	1.00	0
Tennessee Elec. Power Co., Harriman, Tenn.		18.0 Lime	0.75	1.5	2.00	1.25
Thomaston, Ga.	0.75	11.0 Lime	0.45	1.7	2.13	1.68
Winchester, Mass. (New Well Field Only)	0.4	18.7 NaOH 7.5 Silicate	3.56 .93 4.49	2.0	2.67	1.82*
Bamberg, S.C.	0.2	10 Caustic	1.81	1.0	1.33	0.48*
Batesburg, S.C.	0.12	Soda Ash to pH 8.4	—	2.0	2.67	—
Bristol, Conn.	3.0	8 Lime	0.33	1.5	2.00	1.07
California Water Service Co., San Mateo & San Carlos, Calif.		7 Lime	0.29	1.0	1.33	1.04
Haledon, N.J.	0.5	40	1.60	1.0	1.33	0.27
Cedar Grove, W.Va.	0.05	Lime to pH 10.0	—	1.0	1.33	—
Fairhaven, Mass.	0.45	—	—	1.0	1.33	—
Freeport, N.Y.		—	—	0.25 Lime —	0.33 †	—
Greenwood, S.C.		To pH 8.3	—	1.0	1.33	0
Hempstead, N.Y.	3.0	7.4 Lime	0.62	0.5 Lime 3.7	0.67 .32	0.37
Newport, R.I.		pH 9.0	—	1.5	2.00	—

* Decrease.

† "Calgon used to make lime effective."

their meaning. Another reason is the multiplicity of indefinite and complex benefits some believe to exist but which have not yet been proved.

As a rule, a small water system will require larger quantities of metaphosphate per million gallons of water treated than do the larger systems.

No plants known to be using metaphosphates alone for corrosion control use less than $8\frac{1}{3}$ lb. per mil.gal. It appears that if complete protection is desired throughout the entire system, the residual must be kept at not less than 0.5 ppm. To maintain this minimum through domestic hot-water tanks and into the dead ends, the quantity of metaphosphate that must be applied at the plant may be as much as 17 lb. per mil.gal. or more.

Table 6 gives certain data received from those water supplies reporting the use of metaphosphates at the time this report was prepared.

The gross cost of the treatment at these plants is apparent, but the net cost should certainly include consideration of:

1. The cost of the corrosion control chemicals that are displaced.
2. The reduction of water wasted by flushing the system.
3. Reduction in the depreciation of the distribution system.
4. Improved pressures and reduced pumping cost because of less pipe friction.
5. The increased good will resulting from the improved appearance of the water.
6. The saving to the user in the cost of soap and other chemicals used in domestic and industrial establishments.

Conclusions

The following conclusions may be drawn, on the basis of information at present available to the Committee:

1. In ferrous metal piping systems, the use of metaphosphates will nearly always eliminate, or at least minimize, the outward manifestations of corrosion, particularly red water and tuberculation. This conclusion is derived largely from operating experience and is substantiated in laboratory studies.

2. Conflicting evidence as yet forbids a definite statement as to whether metaphosphate does or does not prevent the actual corrosion of ferrous metals, using the term corrosion in the sense of removal of metal from the surface. The members of the committee are not in agreement on this question.

3. The effectiveness of metaphosphate in preventing attack on nonferrous metals seems to depend on the metal, and on the particular aspect of corrosion studied. Prevention of precipitates of metal salts and of stains on fixtures seems to be well authenticated. The prevention of penetration and pitting by metaphosphate is at present in doubt in the

case of copper, brass and zinc. The action of metaphosphate on lead is to reduce the amount of lead taken up by waters of pH value lower than 7.0, and possibly to increase it slightly in waters of pH value greater than 8.0.

4. Disturbances in water systems produced by the addition of metaphosphate, such as sloughing of scale deposits on pipe and increased bacterial counts, do not seem to be sufficiently common to cause concern, but abrupt changes in pH value should be avoided when metaphosphate treatment is introduced.

5. Metaphosphate has been used to advantage in conjunction with other chemicals commonly used for corrosion control, such as lime, soda ash or caustic soda. Of these, lime is the one generally used. In such combined treatments, the metaphosphate provides an additional benefit by preventing deposition of calcium or magnesium salts in the system, particularly in hot water coils or piping.

6. On the basis of chemical cost only, metaphosphate treatment appears more expensive than most other forms of anti-corrosion treatment; however, when lime treatment and metaphosphate treatment are compared, attention must be given to the cost of the additional soap used by the consumer if lime treatment is adopted. Other benefits secured by metaphosphate treatment, such as the prevention of red water and tuberculation must also be considered.

7. In connection with the action of metaphosphate in preventing red water, it is noted that this chemical may be used to prevent the precipitation of iron and manganese in water.

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Discussion by *Frank E. Hale.* * There is no question as to the ability of hexametaphosphate to form complex salts with calcium, iron and probably lead or other bases. Its use therefore to prevent calcium carbonate deposits in boiler feed pipes, hot water heating coils and to prevent red water does not seem to be open to question. Added to well waters containing a small excess of iron prior to oxidation of the iron holds the iron in practically colorless solution for a considerable period of time, thus reducing complaints of red water. That the iron is held in ferrous condition would be indicated by the fact that sodium silicate, having a high ratio of silica to sodium, will also hold iron in solution for months; but there is an immediate deepening of color by change of the iron to ferric condition, whereas with the phosphate the solution is of low color. The above, however, does not interfere with the darkening of tea or vegetables by combination of iron with tannates or effect upon flavor. If possible removal of the iron would seem preferable.

It seems essential, however, that a word of warning be uttered concerning the statement that hexametaphosphate prevents or reduces *corrosion*, particularly *with soft waters* of acid pH. There is very little exact data to prove this assertion. Most of the data refer to the appearance of treated water, lack of red water and lack of reduced flow. None of these present any proof that corrosion is not taking place.

In the first place there is no question that strong solutions of hexametaphosphate are very corrosive. This is shown by necessity of protect-

* Director of Labs., Dept. of Water Supply, Gas & Electricity, New York. This discussion was submitted after the committee report had received the unanimous approval of the committee. It, therefore, represents the personal views of the author rather than those of the committee as a whole.

ing feeding equipment and pipes which may be rapidly eaten through. (At Jamaica, L.I., soda ash is added to the strong solution to help prevent corrosion of equipment. Hypochlorite is also added to prevent growth of *Esch. coli* in the phosphate solution.) Why, therefore, should dilute solution not be corrosive. The salt slowly hydrolyzes so that there is really present an acid phosphate salt.

Loss of head data* indicate more corrosion by treated water than by untreated water. It is well established that the more acid the pH the greater the corrosion and the Calgon-treated water shows even greater effect at each pH. The fact that the dissolved iron is carried through the pipe and held in solution prevents increased loss of head. It tends to keep a clean iron surface. Tuberculation may be less with treated water but pitting may still be taking place.

Determination of dissolved iron at the tap is not conclusive. Carried through as fast as formed it amounts to at most a few tenths of a part per million. Most red water is caused by sudden dislodging of *accumulated* deposits of iron oxide. Again, the amount of iron held by the phosphate is not readily completely determined by the usual method employed. Considerable care must be taken in this determination. Short time experiments are not conclusive. They must be carried over a long period of time to get the real effect on piping. This may be due to the small amounts of phosphate used.

Experiments on Mild Steel Tape

Experiments at Mt. Prospect Laboratory with mild steel tape enclosed in glass tubing with running water, both untreated and treated, have shown serious, increased corrosion by the treated water, the tape being riddled with holes. The only criticism made of these experiments is that the rate of flow is not rapid enough to approach normal use. In normal use water stands in pipes and also flows at a large variety of rates. At high rates of flow, hydrogen of polarization may be swept away, thus of itself causing corrosion and confusing the results. In experiments to get exact data, the flow must be such that there is a definite drop in dissolved oxygen and a decided loss of weight of the specimen. The strips of black mild steel were all cut from the same sheet of metal and were approximately 78 cm. × 1.5 cm. × .05 cm. Each weighed about 35 grams originally. Rates of flow were 4 gpd. and 48 gpd. Amount of Calgon used was 2 ppm. in the treated water. The first set of experiments lasted 46 days. The strips were then cleaned merely by rubbing off the deposited rust and weighed. There was very little difference in loss of weight. In fact, it

* RICE, OWEN. Recent Developments in the Use of Hexametaphosphate in Water Treatment. J.N.E.W.W.A., **56:** 84 (1942) (*see* Fig. 3).

was slightly less for the treated water. Re-test was then carried on for 77 days. The results were decidedly different. The metaphosphate-treated water showed much greater loss than the untreated water at both the low and the high flow. The treated water at low flow showed a loss of 6.2 g. out of 32.4 g. total weight to 4.9 g. out of 31.2 g. total weight for the untreated water. On the high flow the treated water showed a loss of 11.0 g. out of 30.5 g. total weight to 7.5 g. out of 30.3 g. total weight by the untreated water. Holes were eaten completely through the steel tape by the treated water. It was riddled.

Other experiments and long experience have indicated that phosphates also corrode zinc.

Of course, pipes are much thicker than these steel tapes and it may take a long interval of use in buildings to show leakage, but experience with certain (untreated) soft well waters of low pH has shown dezincification of hot pipes at the threads in about 3 years. Any increase of corrosion by metaphosphate treatment would be disastrous.

In general, galvanized pipe, brass pipe or copper pipe is used in buildings. Any leakage developing in tall buildings as in New York City would make replacement expensive and difficult and for the duration of the war replacement is practically impossible.

A Summary of Census Data on Water Treatment Plants in the United States

By S. R. Weibel

CONCURRENTLY with the nationwide census of sewerage systems in continental United States, begun in February 1939, a summary of which has been published in the March 20, 1942 issue of *Public Health Reports*, the U.S. Public Health Service had conducted a similar census of water treatment plants.

The data on which the census has been based were furnished by the sanitary engineering divisions of the various states on data forms for individual plants, distributed through the District Offices of the U.S.P.H.S. The completed individual forms were returned to the Cincinnati Station, where the material was condensed and compiled on tabulation forms, copies of which were sent back to the respective states for checking. The checked and corrected material was then mimeographed and arranged in individual pamphlets by states, for general distribution.

Grateful acknowledgement is due to the personnel of these organizations, who have collaborated both willingly and effectively in the very considerable task of furnishing basic data in detail for the individual plants, at a cost of much time and effort. In some instances the records of the divisions were made available to representatives of the U.S.P.H.S. for transcription.

Since the checked tabulations were received throughout the year 1941 and in one instance, in early 1942, the mimeographed booklets for water treatment plants represent substantially the status of these plants at the close of 1940, with 1941 data included in some states.

Each mimeographed booklet presents a tabulation of individual plants in the state serving communities of a resident population of 100 or more. The tabulations for each plant show the population of communities served, plant ownership, sources of supply, date started, rated capacity, population

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A summary prepared by S. R. Weibel, P. A. Sanitary Engineer (R), U.S. Public Health Service and published by permission of the Assistant Surgeon General, U.S. Public Health Service, Washington, D.C.

served, output, treatment facilities or practices, laboratory control where furnished by a plant and water storage capacity. In addition, most plants are identified as to principal functional use, such as purification, softening, iron and manganese removal, etc. With a few modifications, these classifications have been used in the summaries herein presented.

The assembly, compilation and presentation of detailed data in mimeographed pamphlets for each state was organized and conducted by Passed Assistant Sanitary Engineer Vernon G. McKenzie at the U.S.P.H.S. Stream Pollution Investigations Station at Cincinnati.

The summary has been divided into five tables for convenience in presentation, Table 1 being a general integration of the data on the plants classified in Tables 2, 3 and 4, together with information on communities, ownership, and sources of supply. Tables 2, 3 and 4 contain the classified tabulations of plants, together with their respective populations served, output and percentage capacity operation, where such information was substantially complete. Table 5 presents an independent summarization of selected facilities or practices of interest drawn from all types of plants. All tables appear at the end of the paper.

Explanatory Notes

In summarizing the census data, it became evident that, because of omissions of basic data on population served and output for many of the individual plants, a complete and useful summary of these items for some states could not be given at this time. For most states these items were fairly complete and, by filling in the small percentage of omissions encountered in these cases, a more complete and substantially correct summary has been made possible for the bulk of the states. Omissions in population served were supplied from the population of the individual community and the output, estimated as 100 gpd. per capita, applied to the population served. A similar procedure was followed in the case of a few capacities supplied in terms of output figures.

Enumeration of plants by number under general classifications and selected facilities is fairly complete for the country as a whole. The case of omissions due to lack of detail are covered in the footnotes. In cases of communities supplied by two or more plants of dissimilar classification, the total population served has, in general been allocated to the separate plants in proportion to their respective outputs. In the absence of these figures or, where output was also reported as a total figure, the breakdown was made on the basis of capacity. A few cases in which such procedure was not considered practicable are covered by footnotes. Plant ownership figures in some instances fall short of the total number of plants reported because of the omission of plants with ownership unknown and

cases in which "both" types of ownership were reported. It is hoped, by subsequent annual supplements and revisions, to iron out such difficulties and gradually to complete, insofar as possible, the basic information on all plants.

Summary of Data Presented

Table 1 is a general summary of population, sources of supply and treatment plants. From it, some general observations may be drawn. Assuming the populations served, in 7 states and the District of Columbia for which figures are lacking, to be approximately equal to the census populations of the communities served (shown in parentheses), the total population served by community water treatment plants in continental United States is about 74,300,000 or equivalent to practically 100 per cent of the urban and 56 per cent of the total population according to the U.S. Census of 1940. Raw water supplies are drawn for treatment from surface sources at 2,618, or 49 per cent of the total number of plants for which sources are known; 2,486, or 46 per cent, from ground sources; and 262, or 5 per cent, for combinations of both surface and ground sources. On the basis of the 62,500,000 population served in the 41 states for which this information is available, 73 per cent received treated water from surface sources, 19 per cent from ground sources, and 8 per cent from combinations of the two. It may be mentioned in this connection that, in order to avoid duplication or confusion in the data presented, emergency or auxiliary plants and water supplies, where readily identified, were not enumerated. Some of the supplies reported as both "surface" and "ground" may result from the inclusion of a separate or auxiliary supply not thus identified.

Water treatment plants of all types considered total 5,372, of which, on the basis of known cases, 69 per cent are municipally owned and 31 per cent are privately owned.

Based on the 29 states for which both population served and total output figures are available, the 49,963,000 population served and 5,943 mgd. output indicate an average per capita plant output of 119 gpd.

Tables 2, 3 and 4 present summaries of plants classified as to type or principal functions. With slight modification, these were adapted from the basic classifications of the mimeographed booklets giving the data for individual plants. The elements presented under each classification include number of plants, population served, plant output and percentage capacity operation. These are summarized in Table 1.

Table 2 summarizes data on rapid sand filter purification plants, including those having adjunctive functions, such as iron and manganese removal or softening, or both.

Table 3 includes data on slow sand filter purification plants and other plants whose classified functional use is iron and manganese removal or softening, or both.

Table 4 is a summary of data on all plants not included in the above categories. These are subdivided into two miscellaneous groups: the one consisting of plants providing chlorination only, or chlorination plus other treatment short of rapid or slow sand filtration; and the other, of plants providing similar miscellaneous treatment without chlorination. In connection with the latter group, it is to be pointed out that plants in Tables 2 or 3 do not necessarily provide chlorination.

The percentage distribution of plants by number and population served for the 32 states* for which both figures are available is as follows:

TABLE NO.	CLASSIFICATION	PERCENTAGE OF TOTAL BY:	
		Number	Pop. served
2	Rapid sand filter purification plants	34.4	53.1
2	Purification only	(30.6)	(44.0)
2	Purification and iron and manganese removal	(0.2)	(0.5)
2	Purification and softening	(3.6)	(8.6)
2	Purification, iron and manganese removal and softening	(0)	(0)
3	Slow sand filter purification plants	1.7	8.7
3	Iron and manganese removal plants	9.7	3.0
3	Softening plants	5.8	2.7
3	Combination iron and manganese removal and softening plants	1.9	0.7
4	Simple chlorination and miscellaneous treatment (with chlorination)	43.8	31.1
4	Miscellaneous treatment (without chlorination)	2.7	0.7
Total for 32 states		100	100

Table 5 summarizes selected information drawn from all plants regardless of type or function. The items presented include chlorination, softening, iron and manganese removal, rapid sand filtration, ammoniation, activated carbon and laboratory control (by plant laboratories). Additional details, such as information on type of aeration, mixing, sedimentation basins, coagulants used, application of chlorine or ammonia as gases or compounds, recarbonation and corrosion control practices and water storage capacities, are available in the detailed mimeographed booklets. Most of these items are not at present suitable for complete presentation by states, because of omissions in detail in many instances.

* Representing 65 per cent of the 48 states and the District of Columbia, 64 per cent of plants enumerated and 50 per cent of total estimated population served.

Referring to chlorination in Table 5, it appears that 86 per cent of the total number of plants provide chlorination. On a flow basis, about 94 per cent of the total 6,005 mgd. for the 30 states for which output data are available receives chlorination, as compared with 85 per cent on the basis of number of plants. Referring to softening, it appears that, on the basis of the number of plants, lime or lime-soda softening constitutes 69 per cent and zeolite 31 per cent in the 33 states which practice softening. Of the 33 states having softening plants, 20 give output figures showing that, whereas on a plant enumeration basis the percentage distribution is about the same as above (67 and 33 per cent respectively), on the basis of plant output, lime or lime-soda softening is used for 94 per cent of the output, as against 6 per cent for zeolite, indicating the use of zeolite in small installations. The hypothetical average output for plants having softening in these same states is about 1.29 mgd. per plant for lime or lime-soda as against 0.18 mgd. per plant for zeolite.

Gravity or pressure rapid sand filters are identified at 2,278, or 42 per cent of the total number of plants in the country. In the 30 states* in which rapid sand filters were completely identified and for which output figures were available, gravity filters are used in 82 per cent and pressure filters in 18 per cent of the installations. On a flow basis for the same plants, gravity filters handle 96 per cent of the total output and pressure filters 4 per cent, indicating that on the average, pressure filter installations are small.

Ammoniation is practiced at 676 plants, or 13 per cent of the total plants surveyed and at 15 per cent of all of the plants using chlorine. Activated carbon is used at 720 plants.

Plant laboratory control is reported for 1,286 plants, or 24 per cent of the total plants, with a distribution of 47 per cent chemical control, 5 per cent bacteriological control, and 48 per cent both.

Iron and manganese removal is practiced at 598 plants in 36 states, or in about 12 per cent of the total plants in those states.

It is hoped to compile and issue annual supplements to the individual state booklets showing new installations and additions to existing plants and an annual summary similar to the one here presented. This will provide the opportunity to complete gradually the detailed information on existing plants toward the ultimate objective of a complete, authentic, and up-to-date annual record of community water treatment in the United States. At intervals of five or ten years, this information can be incorporated into a complete inventory of plant detail brought to date. Although some of this work may have to be curtailed during the war period, it is hoped that the plan indicated may be followed as an ultimate objective.

* Includes New York State exclusive of New York City.

TABLE 1

General Summary

STATE	POPULATION			SOURCE OF TREATED WATER SUPPLIES						TREATMENT PLANTS—ALL TYPES				
	U.S. Census—1940		Estimated population served*	Surface		Ground		Both		No.	Ownership		Rated plant capac., mgd.	Plant output, mgd.
	Total	Urban		No.	Estimated population served	No.	Estimated population served	No.	Estimated population served		Public	Private		
Alabama	2,832,961	855,941	1,049,000	59	768,700	104	258,700	5	21,900	168	84	84	163	84
Arizona	499,261	173,981	(151,000)	3		16		4		23	10	12		
Arkansas	1,949,387	431,910	439,000	28	273,600	58	145,900	2	19,100	88	61	27		33
California	6,907,387	4,902,265	4,224,000	79	1,480,000	36	485,100	17	2,258,400	132	78	53		
Colorado	1,123,296	590,756	497,000	34	473,600	6	22,200	1	1,000	41	40	1	261	108
Connecticut	1,709,242	1,158,162	1,474,000	70	1,448,600	10	21,600	2	3,700	82	26	56		164
Delaware	266,505	139,432	129,000	3	129,000	0	—	0	—	3	2	1	33	15
District of Columbia	663,091	663,091	(487,000)	2		0	—	0	—	2	2	—	160	
Florida	1,897,414	1,045,791	704,000	16	146,900	53	521,200	2	36,000	71	51	18	181	85
Georgia	3,123,723	1,073,808	927,000	70	672,000	93	243,300	4	12,100	167	138	29	185	106
Idaho	524,873	176,708	94,000	11	44,300	6	30,100	2	19,400	19	13	5		
Illinois	7,897,241	5,809,000	(5,804,000)	107		142		2		251	225	25		1,060
Indiana	3,427,796	1,887,712	1,795,000	45	1,097,000	140	616,500	2	81,000	187	142	44	460	196
Iowa	2,538,268	1,084,231	1,120,000	36	353,100	160	752,400	2	14,700	198	191	7		
Kansas	1,801,028	753,941	746,000	55	458,300	48	278,700	3	9,300	106	97	9	189	80
Kentucky	2,845,627	849,327	1,052,000	93	898,700	74	125,100	10	28,500	177	121	56		94
Louisiana	2,363,880	980,439	793,000	24	744,800	13	48,500	0	—	37	23	13	169	80
Maine	847,226	343,057	474,000	73	418,700	16	42,300	7	13,000	96	38	58		
Maryland	1,821,244	1,080,351	1,525,000	23	1,336,300	25	157,500	9	31,000	57	31	26		
Massachusetts	4,316,721	3,859,476	3,303,000	60	2,769,500	28	419,600	14	114,300	102	85	17		293
Michigan	5,256,106	3,454,867	(3,176,000)	67		26		3[a]		98	81	14		
Minnesota	2,792,300	1,390,098	1,144,000	30	710,100	41	145,800	1	287,700	72	68	4	438	104
Mississippi	2,183,796	432,882	251,000	3	104,000	27	114,800	1	32,000	31	20	3	43	21
Missouri	3,784,664	1,960,696	2,002,000	64	1,814,400	59	121,700	3	66,000	126	97	27	478	242

Missouri	3,784,664	1,960,696	2,002,000	64	1,814,400	59	121,700	3	66,000	126	97	27	478	242
Montana	559,456	211,535	232,000	31	197,000	12	14,500	3	20,100	46	36	9		
Nebraska	1,315,834	514,148	(411,000)	8		21		0	—	29	27	2		
Nevada	110,247	43,291	(38,000)	4		3		1		8	3	5		
New Hampshire	491,524	283,225	278,000	29	189,600	11	73,800	4	14,300	44	32	12		
New Jersey	4,160,165	3,394,773	3,564,000	42	2,315,400	123	1,059,500	10	189,500	175	92	83		375
New Mexico	531,818	176,401	97,000	8	43,500	6	53,000	0	—	14	8	6	14	7
New York	13,479,142	11,165,893	11,566,000	271	8,934,000	135	1,502,000	24[b]	1,130,000[b]	431	298	119		1,567
North Carolina	3,571,623	974,175	1,175,000	121	1,084,100	41	89,800	1	600	163	137	19		
North Dakota	641,935	131,923	105,000	9	88,900	8	14,500	1	1,100	18	15	0		9
Ohio	6,907,612	4,612,986	4,530,000	85	3,476,800	139	966,700	5	86,100	229	204	25		476
Oklahoma	2,336,434	879,663	819,000	77	722,100	22	74,600	4[c]	13,300[c]	104	98	6		
Oregon	1,089,684	531,675	(528,000)	63		15		8		86	61	25		
Pennsylvania	9,900,180	6,586,877	8,122,000	326	6,967,000	206	675,300	71	479,700	603	204	391		1,003
Rhode Island	713,346	653,383	657,000	12	646,600	4	7,400	1	3,000	17	6	11		51
South Carolina	1,899,804	466,111	553,000	40	462,100	23	80,600	2	10,200	65	58	7	120	53
South Dakota	642,961	158,087	112,000	8	59,100	22	43,100	1	10,200	31	29	2		
Tennessee	2,915,841	1,024,637	1,098,000	27	578,100	99	493,500	4	26,000	130	99	31		103
Texas	6,414,824	2,911,389	2,271,000	123	1,385,100	100	878,600	3	7,500	226	181	45		
Utah	550,310	305,493	230,000	7	5,700	13	77,200	2[d]	146,800[d]	24	18	6		
Vermont	359,231	123,239	61,000	7	58,700	1	2,000	0	—	8	6	2		9
Virginia	2,677,773	944,675	(1,196,000)	74		73		6		153	101	51		
Washington	1,736,191	921,969	1,067,000	59	736,700	23	244,000	7	85,900	89	59	27		360
West Virginia	1,901,974	534,292	787,000	100	523,100	134	259,100	6	4,600	240	78	162		56
Wisconsin	3,137,587	1,679,144	1,363,000	21	976,200	66	378,600	1	8,000	88	81	7	409	153
Wyoming	250,742	93,577	88,000	11	39,900	5	24,600	1	23,500	17	13	3	43	16
Totals	131,669,275	74,421,133	74,308,000	2,618	45,631,300	2,486	11,563,400	262	5,369,500	5,372	3,668	1,645	3,346	7,003

* The figures in parentheses are assumed values, equal to the Census populations of the communities served.

[a] Exclusive of 2 sources unknown.

[b] Exclusive of 1 source unknown, serving 240.

[c] Exclusive of 1 source unknown, serving 8,537.

[d] Exclusive of 2 sources unknown, serving 600.

TABLE 2

Classified Plant Summary—Rapid Sand Filter Purification Plants

STATE	PURIFICATION				COMBINED PURIFICATION & IRON & MANGANESE REMOVAL				COMBINED PURIFICATION & SOFTENING				COMBINED PURIFICATION, IRON & MANGANESE REMOVAL & SOFTENING			
	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	No.	Estimated population served	Plant output, mgd.	Percentage of capac.
Alabama	63	677,300	50.69	55	0	—	—	—	0	—	—	—	0	—	—	—
Arizona				—	0	—	—	—	0	—	—	—	0	—	—	—
Arkansas	29	293,200	22.27	48	1	500	0.05		0	—	—	—	0	—	—	—
California	35[b]	861,100			0	—	—	—	0	—	—	—	0	—	—	—
Colorado	23	346,600	75.42	38	0	—	—	—	0	—	—	—	0	—	—	—
Connecticut	20	327,800	36.38	68	0	—	—	—	0	—	—	—	0	—	—	—
Delaware	2	7,000[c]	0.35[c]	58[c]	0	—	—	—	0	—	—	—	0	—	—	—
Dist. of Columbia	1				0	—	—	—	0	—	—	—	0	—	—	—
Florida	9[d]	87,100	10.53	29	0	—	—	—	5	128,300	14.66	59	0	—	—	—
Georgia	71	667,300	78.96	60	2	10,800	0.90	39	1	6,000	1.50	65	0	—	—	—
Idaho	3	14,900	4.62	57	0	—	—	—	0	—	—	—	0	—	—	—
Illinois	93		66.03	39	0	—	—	—	8		18.96	47	3		11.08	97
Indiana	38	582,100[e]	74.07[e]	52[e]	0	—	—	—	1	100,000	11.10	46	1	7,800	0.90	45
Iowa	27	192,700	15.44	45	0	—	—	—	6	128,300	11.00	41	0	—	—	—
Kansas	40	277,400	32.04	53	0	—	—	—	17	174,700	17.19	38	0	—	—	—
Kentucky	95	902,100	85.35	37	0	—	—	—	3	5,500	0.16	14	0	—	—	—
Louisiana	5	97,600	7.42	41	0	—	—	—	16	618,600	63.24	47	0	—	—	—
Maine	13	75,300	7.72	36	0	—	—	—	0	—	—	—	0	—	—	—
Maryland	3[f]	1,117,400	119.00		0	—	—	—	0	—	—	—	0	—	—	—
Massachusetts	9	292,700	26.38	55	0	—	—	—	0	—	—	—	0	—	—	—
Michigan	32		333.76	45	0	—	—	—	10		37.83	41	0	—	—	—
Minnesota	11	372,800	35.88	17	0	—	—	—	7	309,000	23.00	49	0	—	—	—
Mississippi	4	136,000	11.45	53	0	—	—	—	0	—	—	—	0	—	—	—
Missouri	69	1,841,600	229.00	52	0	—	—	—	5	44,500	3.83	29	0	—	—	—
Montana	8	72,200	19.27	48	0	—	—	—	2	10,600	1.25	31	0	—	—	—
Nebraska	7				0	—	—	—	0	—	—	—	0	—	—	—
Nevada	1	3,000	1.50	130	1	600	0.06	24	1	2,500	1.50	100	0	—	—	—
New Hampshire	6	16,200	1.73		0	—	—	—	0	—	—	—	0	—	—	—
									0	—	—	—	0	—	—	—

Mississippi	69	1,841,600	229.00	52	0	—	—	—	5	44,500	3.85	29	0	—	—	—	
Missouri	8	72,200	19.27	48	0	—	—	—	2	10,600	1.25	31	0	—	—	—	
Montana	[a]				0				0				0				
Nebraska	1	3,000	1.50	130	1	600	0.06	24	1	2,500	1.50	100	0	—	—	—	
Nevada	6	16,200	1.73		0	—	—	—	0	—	—	—	0	—	—	—	
New Hampshire	28[g]	1,232,700	107.25		0	—	—	—	0	—	—	—	0	—	—	—	
New Jersey	3	8,500	0.32	77	0	—	—	—	0	—	—	—	0	—	—	—	
New Mexico	96	1,891,200	269.81		1	3,200	0.40	19	0	—	—	—	0	—	—	—	
New York	92	883,600			0	—	—	—	1	1,800			0	—	—	—	
North Carolina	6	26,500	2.56	62	0	—	—	—	5	70,800	6.16	32	0	—	—	—	
North Dakota	53	2,305,800	265.96	48	0	—	—	—	33	1,261,300	129.81	42	0	—	—	—	
Ohio	34[h]	185,300			0	—	—	—	2[j]	216,700			0	—	—	—	
Oklahoma	15				0	—	—	—	0	—	—	—	0	—	—	—	
Oregon	162	2,809,300	299.16		3	169,200	11.05		14	372,100	27.83		0	—	—	—	
Pennsylvania	8	567,800	45.14	42	0	—	—	—	0	—	—	—	0	—	—	—	
Rhode Island	40	391,900	39.70	50	0	—	—	—	0	—	—	—	0	—	—	—	
South Carolina	5	33,500	2.65	33	0	—	—	—	3	30,200	2.62	41	0	—	—	—	
South Dakota	36[k]	628,500	61.90	43	0	—	—	—	0	—	—	—	0	—	—	—	
Tennessee	70	1,249,500			0	—	—	—	3	39,400			0	—	—	—	
Texas	3	1,900			0	—	—	—	0	—	—	—	0	—	—	—	
Utah	2	27,300	1.73	58	0	—	—	—	0	—	—	—	0	—	—	—	
Vermont	55[l]				0	—	—	—	1				0	—	—	—	
Virginia	8	34,600	7.8		0	—	—	—	0	—	—	—	0	—	—	—	
Washington	81[m]	389,800	28.75		0	—	—	—	8[n]	108,200	8.78		0	—	—	—	
West Virginia	15	950,100	114.30	40	0	—	—	—	1	9,500	0.47	23	0	—	—	—	
Wisconsin	6	42,400	8.56	45	0	—	—	—	0	—	—	—	0	—	—	—	
Wyoming																	
Totals	1,535	22,921,600	2,600.	—	8	184,300	12.	—	153	3,638,000	381.	—	4	7,800	12.	—	

[a] Total of 3 filter purification plants in state; type filters not specified.

[b] Exclusive of 1 plant, serving estimated 9,400; type filter not specified.

[c] Exclusive of Wilmington; total pop. served 122,000 and total output 14.3 mgd., furnished by 1 rapid sand and 1 slow sand filter plant.

[d] Exclusive of 1 purification plant; capacity 0.51 mgd.; pop. served 3,500; output 0.15 mgd.; type filter not specified.

[e] Exclusive of Indianapolis; total pop. served 375,000 and total output 33.5 mgd., furnished by 2 rapid sand and 1 slow sand filter plant and an untreated well supply.

[f] Exclusive of 13 purification plants; pop. served 212,700; output 23.93 mgd.; type filters not specified.

[g] Exclusive of 1 purification plant; pop. served 2,900; output 0.50 mgd.; type filter not specified.

[h] Exclusive of 30 purification plants; pop. served 347,500; type filter not specified.

[j] Exclusive of 2 purification-softening plants; pop. served 2,700; type filter not specified.

[k] Exclusive of 1 purification plant; pop. served 1,300; capacity 0.30 mgd; output 0.14 mgd.; type filter not specified.

[l] Exclusive of 3 purification plants; type filter not specified.

[m] Exclusive of 1 purification plant; pop. served 400; output 0.005 mgd.; type filter not specified.

[n] Exclusive of 1 purification-softening plant, serving 75; type filter not specified.

TABLE 3

Classified Plant Summary—Slow Sand Filter Purification Plants, Iron and Manganese Removal and Softening Plants

STATE	SLOW SAND FILTER PURIFICATION				IRON & MANGANESE REMOVAL				SOFTENING				COMBINED IRON & MANGANESE REMOVAL & SOFTENING			
	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	No.	Estimated population served	Plant output, mgd.	Percentage of capac.
Alabama	2	2,900	0.13	23	9	24,300	1.07	44	3	900	0.04	33	0	—	—	—
Arizona	[a]				0	—	—	—	1				0	—	—	—
Arkansas	0	—	—	—	34	68,800	4.53		1	2,300	0.23	29	3	13,200	0.85	32
California	2	22,700			2	9,000			11	149,700			0	—	—	—
Colorado	2	67,000	16.00	45	0	—	—	—	0	—	—	—	0	—	—	—
Connecticut	6	285,300	26.62	71	0	—	—	—	0	—	—	—	0	—	—	—
Delaware	1	[b]	[b]	[b]	0	—	—	—	0	—	—	—	0	—	—	—
Dist. of Columbia	1				0	—	—	—	0	—	—	—	0	—	—	—
Florida	0	—	—	—	5	5,900	0.56	20	16	196,700	28.82	62	2	20,800	2.66	63
Georgia	0	—	—	—	6	6,500	0.62	42	3	13,600	1.18	32	0	—	—	—
Idaho	0	—	—	—	0	—	—	—	0	—	—	—	0	—	—	—
Illinois	0	—	—	—	30		7.03	56	5		2.10	33	53		13.33	41
Indiana	1	[c]	[c]	[c]	14	113,900	11.64	40	2	2,500	0.09	10	10	26,200	2.50	35
Iowa	0	—	—	—	71	122,900	7.02	30	28	85,600	6.22	38	3	2,700	0.10	25
Kansas	0	—	—	—	10	129,300	12.80	63	5	25,900	2.18	40	3	13,400	2.21	58
Kentucky	1	1,700	0.07	65	5	9,400	0.67	25	12	46,600	3.38	57	3	2,200	0.07	37
Louisiana	1[d]	400	0.40	80	3	18,800	1.69	45	11	55,700	6.98	53	0	—	—	—
Maine	5	20,300	1.73		2	9,500	1.26		0	—	—	—	0	—	—	—
Maryland	0	—	—	—	6	8,400	1.65		1	1,000			0	—	—	—
Massachusetts	17	378,300	33.20	55	11	219,000	14.77	49	0	—	—	—	0	—	—	—
Michigan	0	—	—	—	3		4.73		3				3		2.68	67
Minnesota	0	—	—	—	27	82,900	6.90	29	7	214,600	20.78	16	1	1,000	0.03	14
Mississippi	0	—	—	—	12	47,200	3.44	52	0	—	—	—	1	700	0.03	30
Missouri	1	400	0.004	5	8	14,800	2.14	64	20	36,400	2.57	25	4	9,300	0.74	43
Montana	0	—	—	—	0	—	—	—	1	800			0	—	—	—
									0	—	—	—	5			

Missouri	1	400	0.004	5	8	14,800	2.14	64	20	36,400	2.57	25	4	9,300	0.74	43		
Montana	0	—	—	—	0	—	—	—	1	800			0	—	—	—		
Nebraska	0	—	—	—	9				0	—	—	—	5					
Nevada	0	—	—	—	0	—	—	—	0	—	—	—	0	—	—	—		
New Hampshire	4	21,700	1.67		3	16,800	0.99		0	—	—	—	0	—	—	—		
New Jersey	4	16,600	1.28		25	220,200	16.15		1	14,800	1.25		0	—	—	—		
New Mexico	0	—	—	—	1	35,000	2.50	42	0	—	—	—	0	—	—	—		
New York	29	305,500	34.81		16	117,300[e]	10.36[e]		11	33,000	2.21		0	—	—	—		
North Carolina	3	92,300			11	12,800			3	8,400			3	32,900				
North Dakota	0	—	—	—	2	2,800	0.27		2	2,300	0.18		1	800	0.02	17		
Ohio	0	—	—	—	26	66,300	4.11	36	61	271,400	15.37	32	16	60,700	4.20	44		
Oklahoma	0	—	—	—	0	—	—	—	3	9,500			0	—	—	—		
Oregon	0	—	—	—	0	—	—	—	0	—	—	—	0	—	—	—		
Pennsylvania	14	2,338,500	362.05		4	7,100	0.41		11	145,800	5.24		3	43,000	3.26			
Rhode Island	0	—	—	—	0	—	—	—	0	—	—	—	0	—	—	—		
South Carolina	0	—	—	—	5	14,200	1.13	36	2	11,200	0.55	50	2	2,900	0.13	31		
South Dakota	0	—	—	—	6	11,500	0.88	33	0	—	—	—	2	4,500	0.23	32		
Tennessee	0	—	—	—	12	299,500	25.92	42	0	—	—	—	0	—	—	—		
Texas	0	—	—	—	14	35,500			12	58,500			0	—	—	—		
Utah	0	—	—	—	0	—	—	—	0	—	—	—	0	—	—	—		
Vermont	1	6,600	1.50		0	—	—	—	0	—	—	—	0	—	—	—		
Virginia	0	—	—	—	3				5				0	—	—	—		
Washington	0	—	—	—	1	14,000	1.25	63	0	—	—	—	0	—	—	—		
West Virginia	0	—	—	—	41	68,300	3.00		11	8,600	0.42		8	53,500	3.82			
Wisconsin	1	8,000	1.30	81	19	80,100	7.04	42	6	12,000	0.55	23	12	29,800	2.46	35		
Wyoming	2	11,000	1.40	25	0	—	—	—	0	—	—	—	0	—	—	—		
Totals	98	3,579,200	482.		456	1,892,000	157.		258	1,407,800	100.	—	138	317,600	39.		—	

[a] Total of 3 filter purification plants in state; type filters not specified.

[b] Exclusive of Wilmington; total pop. served 122,000 and total output 14.3 mgd., furnished by 1 rapid sand and 1 slow sand filter plant.

[c] Exclusive of Indianapolis; total pop. served 375,000 and total output 33.5 mgd., furnished by 2 rapid and 1 slow sand plant and an untreated well supply.

[d] Plant also softens; five other slow sand filter plants in state classified functionally as softening plants only.

[e] Exclusive of New York City; data for complete allocation of population served and output to classified plants not at hand. Total population served 7,550,000; total output 998 mgd. Plants enumerated as 15 chlorination, 1 aeration, coagulation, sedimentation and chlorination plant and 8 iron and manganese removal plants, 7 of which have filters. Chlorination enumerated as 1 plant for some supply systems possibly consist of more than 1 plant.

TABLE 4

Classified Plant Summary—Simple Chlorination and Miscellaneous Treatment

STATE	SIMPLE CHLORINATION & MISCELLANEOUS TREATMENT (WITH CHLORINATION)				Adjunctive Facilities							MISCELLANEOUS TREATMENT (WITHOUT CHLORINATION)				Treatment Included				
	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	None	Aeration	Corrosion control	Sedimentation	Coagulation Sedimentation	Ammonia	Other	No.	Estimated population served	Plant output, mgd.	Percentage of capac.	Aeration	Corrosion control	Sedimentation	Coagulation Sedimentation	Other
Alabama	86	334,600	31.99	49	73	5	5	—	1	3	—	5	9,300	0.52	25	5	—	—	—	—
Arizona	19				16	—	—	—	—	3	—	0	—	—	—	—	—	—	—	—
Arkansas	19	60,100	5.33	31	14	1	—	1	2	2	—	1	600	0.03	33	1	—	1	—	—
California	81	3,171,600			55	6	1	4	11	10	2[a]	0	—	—	—	—	—	—	—	—
Colorado	15	82,900	16.05	57	14	—	—	—	1	—	—	1	300	0.10	100	—	—	—	—	1[b]
Connecticut	54	856,200	100.63		45	—	5	1	—	3	—	2	4,600	0.37		—	2	—	—	—
Delaware	0	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—
Dist. of Columbia	0	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—
Florida	18	200,100	22.71	46	10	7	—	—	1	—	—	15	61,800	4.99	30	15	2	—	—	—
Georgia	75	218,000	22.37	55	66	1	5	—	—	1	3[c]	9	5,100	0.32	18	2	8	—	—	—
Idaho	16	78,900			14	—	—	—	—	1	1[d]	0	—	—	—	—	—	—	—	—
Illinois	58		940.96		52	—	1	—	—	5	—	1		0.50		1	—	—	—	—
Indiana	120	587,100	61.98	33	109	5	3	1	2	3	1[e]	0	—	—	—	—	—	—	—	—
Iowa	63	588,000			62	—	—	—	1	1	1[f]	0	—	—	—	—	—	—	—	—
Kansas	21	111,600	12.63	26	20	—	—	—	1	1	—	10	14,000	1.32	28	10	—	10	—	—
Kentucky	53	74,400	3.65		42	6	1	1	4	1	—	5	10,300	0.82	21	4	—	—	1	1[g]
Louisiana	1	2,200	0.22		0	—	—	—	1	—	—	0	—	—	—	—	—	—	—	—
Maine	76	368,800			58	—	2	—	1	17	1[h]	0	—	—	—	—	—	—	—	—
Maryland	27	172,500			22	1	2	—	—	3	—	7	12,800			6	6	—	—	—
Massachusetts	54	2,339,900	215.22		45	—	5	—	—	4	—	11	73,400	5.04		1	11	—	—	—
Michigan	47				41	—	—	—	—	6	—	0	—	—	—	—	—	—	—	—
Minnesota	19	163,300	17.24	22	17	—	—	—	—	2	—	0	—	—	—	—	—	—	—	—
Mississippi	10	62,400	5.04	41	6	3	3	—	—	—	—	4	4,500	0.74	51	4	3	—	—	—
Missouri	19	55,400	3.33	38	11	1	—	1	4	3	—	0	—	—	—	—	—	—	—	—
Nebraska	8				7	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Nevada	5				3	—	—	—	2	2	2[i]	0	—	—	—	—	—	—	—	—
	28	214,700			27	—	1	—	—	—	—	3	8,400			—	3	—	—	—
																7	4			

Mississippi	10	62,400	5.04	41	6	3	3	—	—	—	—	4	4,500	0.74	51	4	3	—	—	—		
Missouri	19	55,400	3.33	38	13	1	—	1	1	3	—	6	—	—	—	—	—	—	—	—		
Nebraska	8				7	—	—	—	1	1	1[j]	6	—	—	—	—	—	—	—	—		
Nevada	5				3	—	—	—	2	2	2[k]	0	—	—	—	—	—	—	—	—		
New Hampshire	28	214,700			27	—	1	—	—	—	—	3	8,400			—	3	—	—	—		
New Jersey	108	2,007,500	242.21		99	6	4	—	—	3	—	9	69,700	5.59		7	4	—	—	—		
New Mexico	10	53,000	4.10	55	5	—	—	3	—	2	—	0	—	—	—	—	—	—	—	—		
New York	270	1,552,300[l]	239.96[l]		217	8	8	1	2	41	3[m]	8	112,800	11.25		3	8	—	—	—		
North Carolina	47	138,800			40	1	1	—	—	5	—	3	3,800			1	4	—	—	—		
North Dakota	1	700	0.03	25	0	—	—	1	—	—	—	1	700			—	1	—	—	—		
Ohio	40	564,100	56.81		39	—	—	—	—	1	—	0	—	—	—	—	—	—	—	—		
Oklahoma	33	56,900			26	—	—	1	6	—	—	0	—	—	—	—	—	—	—	—		
Oregon	70				56	2	1	3	—	12	—	1				—	1	—	—	—		
Pennsylvania	386	2,215,700	291.63		357	11	6	2	2	12	2[n]	6	21,400	2.27		2	3	—	1	—		
Rhode Island	9	89,200	5.36		8	—	1	—	—	—	—	0	—	—	—	—	—	—	—	—		
South Carolina	7	97,600	8.77	34	4	—	3	—	—	1	—	9	35,100	2.31	23	4	7	—	—	—		
South Dakota	15	32,800			10	—	—	—	—	5	—	0	—	—	—	—	—	—	—	—		
Tennessee	77	160,900	14.05		69	4	3	—	5	—	—	4	7,500	1.36		3	1	—	—	—		
Texas	111	841,100			48	9	2	7	36	14	3[o]	16	47,200			10	1	2	5	1[o]		
Utah	19	226,700			11	—	—	1	1	6	—	2	1,700			1	—	—	—	1[p]		
Vermont	5	26,800	5.99		5	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—		
Virginia	85				78	2	3	1	—	2	1[q]	1				—	—	—	—	1[r]		
Washington	80	1,018,100	350.9		68	—	1	—	1	11	—	0	—	—	—	—	—	—	—	—		
West Virginia	86	153,500	11.15		78	3	5	—	1	2	—	3	4,500	0.26		3	—	—	—	—		
Wisconsin	34	273,300	26.63	28	30	1	1	—	—	2	—	0	—	—	—	—	—	—	—	—		
Wyoming	8	33,100	5.50	31	7	—	—	—	—	1	—	1	1,500	0.25		—	—	1	—	—		
Totals	2,529	19,432,700	2,722.	—	2,117	83	73	49	87	194	21	138	511,000	38.	—	83	65	14	7	5		

[a] Contact filter at one plant; activated carbon at other.
[b] Filter only, type not specified.
[c] Calcite sand filters.
[d] Coagulation, sedimentation, contact filter and chlorination at 1 plant.
[e] Activated carbon.
[f] Activated carbon.
[g] Distillation.
[h] Contact filter.
[j] Activated carbon.
[k] Activated carbon at both plants.
[l] Exclusive of New York City; data for complete allocation of population served and output to classified plants not at hand. Total population served 7,550,000; total output 998 mgd. Plants enumerated as 15 chlorination, 1 aeration, coagulation, sedimentation and chlorination plant and 8 iron and manganese removal plants, 7 of which have filters. Chlorination enumerated as 1 plant for some supply systems possibly consist of more than 1 plant.
[m] 2 activated carbon, 1 contact filter.
[n] Activated carbon.
[o] Charcoal filter.
[p] Filter only; type not specified.
[q] Activated carbon filter for de-chlorination.
[r] Granular carbon pressure filter.

TABLE 5

Summary of Selected Facilities at Plants of All Types

STATE	TOTAL PLANTS ALL TYPES		CHLORINATION		SOFTENING				IRON AND MANGANESE REMOVAL		RAPID SAND FILTRATION				Ammonia	Activated carbon	LABORATORY CONTROL (AT PLANT)		
					Lime-Soda		Zeolite				Gravity		Pressure						
	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.			Chemical	Bacteriological	Both
Alabama	168	84	162	83.87	0	—	3	0.04	9	1.07	65	51.48	6	0.24	4	3	69	—	2
Arizona	23		23		0	—	1		0	—	[a]		[a]		4	0	—	—	—
Arkansas	88	33	59	31.46	4	1.08	0	—	38	5.43	41	24.74	7	0.48	5	10	—	—	3
California	132		120		8		3		2		22[b]		18		19	10	—	—	—
Colorado	41	108	34	103.20	0	—	0	—	0	—	21[c]	75.17	2	0.25	0	0	—	—	—
Connecticut	82	164	73	138.42	0	—	0	—	0	—	16	35.51	4	0.87	6	4	9	—	7
Delaware	3	15	3	14.65	0	—	0	—	0	—	2	0.35[d]	0	—	0	0	—	—	—
Dist. of Columbia	2		2		0	—	0	—	0	—	1		0	—	2	2	—	—	2
Florida	71	85	46	78.40	19	44.77	4	1.37	7	3.22	21[e]	31.49[e]	3[e]	0.43[e]	16	10	11	1	7
Georgia	167	106	155	105.18	3	2.50	1	0.18	8	1.52	79[f]	82.40	3[f]	35.93	15	7	38	—	23
Idaho	19		19		0	—	0	—	0	—	3	4.62	0	—	5	3	1	—	3
Illinois	251	1,060	193	1,053.	34	40.58	35	4.89	86	31.44	124	112.53	56	11.18	35	89	120	—	53
Indiana	187	196	183	192.82	3	12.38	11	2.21	25	15.04	45	94.89[g]	11	1.43	24	29	13	8	22
Iowa	198		111		23	16.70	14	0.62	74	7.12	57[h]	35.47	62	3.11	9	26	30	—	10
Kansas	106	80	84	75.56	25	21.58	0	—	13	15.01	69	63.52	4	0.29	23	42	38	—	8
Kentucky	177	94	170	93.26	16	3.59	2	[i]	8	0.74	104	88.71	9	0.47	21	35	36	—	10
Louisiana	37	80	36	79.88	25	70.34	3		3	1.69	22	73.18	4	0.60	3	4	19	—	4
Maine	96		96		0	—	0	—	2	1.26	9	7.11	5	1.56	22	3	1	—	1
Maryland	57		42		0	—	1		6	1.65	3[k]	119.00	1	1.36	5	5	—	—	—
Massachusetts	102	293	70	255.78	0	—	0	—	11	14.77	10	26.69	0	—	7	6	9	—	6
Michigan	98		92		13	49.54	3	[l]	6	7.41	43	382.71	2	1.04	28	29	—	18	42

Michigan	98		92		13	49.54	3		6	7.41	48								
Minnesota	72	104	42	78.82	13	43.75	2	0.11	28	6.93	29	63.00	17	1.68	16	10	—	—	—
Mississippi	31	21	25	19.62	0	—	1	0.03	13	3.47	7	14.15	8	0.64	1	0	—	—	—
Missouri	126	242	107	238.59	19	6.07	10	0.85	12	2.91	85	236.54	9	0.54	22	37	31	—	26
Montana	46		46		2	1.25	1		0	—	10	20.52	0	—	14	5	4	—	2
Nebraska	29		19		4		1		14		16		4		3	4	1	—	—
Nevada	8		8		1	1.50	0	—	1	0.06	1	1.50	2	1.56	2	3	—	—	3
New Hampshire	44		33		0	—	0	—	3	0.99	6	1.73	0	—	0	4	1	—	—
New Jersey	175	375	143	362.64	0	—	1	1.25	25	16.14	26	87.61	27	36.81	35	11	—	—	—
New Mexico	14	7	14	6.92	0	—	0	—	1	2.50	3	2.81	1	0.01	3	1	—	—	—
New York	431	1,567	365	423.95[m]	0	—	11	2.24	9	10.75[m]	70[m]	251.33	35[m]	31.25	82	67	—	17	72
North Carolina	163		147		4		3		14		90		12		29	37	12	—	77
North Dakota	18	9	14	9.00	7	6.34	1	0.01	3	0.29	13	8.94	0	—	6	4	2	—	4
Ohio	229	476	142	462.84	89	143.54	21	5.85	42	8.31	146	410.99	28	3.91	21	32	59	7	87
Oklahoma	104		103[n]		[o]		[o]		0	—	32[p]		4		10	—	—	—	—
Oregon	86		85		0	—	0				8[q]		8[q]		17	8	—	—	—
Pennsylvania	603	1,003	588	999.24	17[r]	28.66[r]	8[r]	5.48[r]	10	14.72	179	563.95	8	9.22	49	56			
Rhode Island	17	51	17	50.50	0	—	0	—	0	—	6	44.20	2	0.94	2	5	1	—	2
South Carolina	65	53	49	49.02	1	0.50	3	0.18	7	1.26	43	40.32	3	1.01	16	19	3	—	26
South Dakota	31		29		5	2.85	0	—	8	1.11	14	6.24	2	0.14	9	2	—	—	—

[a] Total of 3 filter purification plants in state; type filters not specified.

[b] Exclusive of 2 plants; type filter not specified.

[c] Exclusive of 1 plant; type filter not specified.

[d] Exclusive of Wilmington; total pop. served 122,000 and total output 14.3 mgd., furnished by 1 rapid sand and 1 slow sand filter plant.

[e] Exclusive of 1 purification plant; capacity 0.51 mgd.; pop. served 3,500; output 0.15 mgd.; type filter not specified.

[f] One plant, 35.2 mgd. output, with both gravity and pressure filters reported in both columns.

[g] Exclusive of Indianapolis; total pop. served 375,000 and total output 33.5 mgd., furnished by 2 rapid sand and 1 slow sand filter plant and an untreated well supply.

[h] Exclusive of 3 plants; type filter not specified.

[j] Output 1 plant 0.02 mgd.; other unknown.

[k] Exclusive of 13 purification plants; pop. served 212,700; output 23.93 mgd.; type filters not specified.

[l] Output 1 plant 0.62 mgd.; other two unknown.

[m] Exclusive of New York City; data for complete allocation of population served and output classified plants not at hand. Total population served 7,550,000; total output 998 mgd. Plants enumerated as 15 chlorination, 1 aeration, coagulation, sedimentation and chlorination plant and 8 iron removal plants, 7 of which have filters. Chlorination enumerated as 1 plant for some supply systems possibly consist of more than 1 plant.

[n] Exclusive of 30 purification plants; pop. served 347,500; type filter not specified.

[o] Seven plants use softening; detail incomplete.

[p] Exclusive of 34 filters; type not specified.

[q] One plant having both gravity and pressure filters carried in both columns.

[r] Exclusive of 3 plants; total output 2.28 mgd.; type softening not specified.

TABLE 5—(*Concluded*)

STATE	TOTAL PLANTS ALL TYPES		CHLORINATION		SOFTENING				IRON AND MANGANESE REMOVAL		RAPID SAND FILTRATION						LABORATORY CONTROL (AT PLANT)		
					Lime-Soda		Zeolite				Gravity		Pressure						
	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	No.	Plant output, mgd.	Ammonia	Activated carbon	Chemical	Bacteriological	Both
Tennessee	130	103	107	77.05	0	—	0	—	12	25.92	32[s]	61.26	5	0.68	10	12	9	—	17
Texas	226		191		10		5		14		62		17		19	27	5	1	52
Utah	24		22		0	—	0	—	0	—	[t]		3[t]		6	0	—	—	—
Vermont	8	9	6	7.52	0	—	0	—	0	—	2	1.73	0	—	0	1	—	—	—
Virginia	153		152		1		5		3		53[u]		6		11	17	3	—	12
Washington	89	360	89	360.0	0	—	0	—	1	1.25	8	7.55	1	1.50	12	0	7	6	—
West Virginia	240	56	202	54.49	22	9.98	6	3.04	49	6.81	90[v]	40.73	40	3.43	13	30	52	1	26
Wisconsin	88	153	59	149.85	9	2.54	10	0.94	31	9.50	26	120.48	19	0.91	13	11	14	5	13
Wyoming	17	16	13	14.13	0		0	—	0	—	4	8.08	2	0.48	2	0	1	—	1
Totals	5,372	7,003	4,590	5,670.	377	510.	170	29.	598	220.	1,818	3,303.	460	154.	676	720	599	64	623

[s] Exclusive of 8 plants; total output 21.50 mgd.; type filter not specified.
[t] Of total of 4 filter plants in state, 3 are of pressure type; other not identified.
[u] Exclusive of 3 purification plants, type filter not specified.
[v] Exclusive of 3 plants; type filter not specified.

Design and Operation Data on Large Rapid Sand Filtration Plants in the U.S. and Canada

By Eugene A. Hardin

WHILE engaged in making the preliminary designs for an additional filter plant at Detroit, in 1926, the author began gathering characteristic data regarding the design and operation of large rapid sand filtration plants in the United States and Canada. These data were obtained from published articles describing existing plants, from the plans of a number of plants and from the annual reports of various water works, but principally from questionnaires sent out to all filter plants in cities of 100,000 or greater population. The general interest in this information then resulted in its publication in the August 1932 issue of the JOURNAL.

Now, after ten years, this summary of filtration plant information has been brought up to date. Data on new plants have been added, the bibliography has been enlarged and the correctness of information on all plants has been verified by correspondence with the local authorities, so that the data presented here include all alterations and additions made since the previous survey. Some errors or omissions, however, may still exist; if so the author will consider it a favor to have them pointed out.

It is believed that all rapid sand plants of considerable size now operating in U.S. and Canadian cities, with populations above the arbitrary limit of 100,000 are now included. Several interesting large plants, such as those at East St. Louis, Ill., Hackensack, N.J., Saginaw, Mich., and Wheeling, W.Va., have been omitted because the population of those cities is less than 100,000. On the other hand, the Memphis, Tenn., plant was omitted because it includes only iron-removal filters and the San Diego, Calif., plant, consisting of wooden-tub filters only, because its characteristics are special.

In studying this information, it should be borne in mind that, while the data on the physical structure remain constant, the operating data will

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A contribution by Eugene A. Hardin, Engr. of Design—Filtration Plants, Bureau of Water, Philadelphia, Pa., bringing up to date his original paper of the same title, which was published in the August 1932 issue of the JOURNAL (vol. 27, p. 1190).

continually vary in the actual running of the plant. Velocities, retention periods and rates of flow are given for the nominal plant capacity throughout and should be consistent. The raw water analyses, chemical dosages, wash water rates and percentages are in most cases the averages for a considerable operating period. In some cases the limits of variation are given.

It is felt that this information will be generally useful in comparing plants, in determining standard American filter plant practice and possibly as a guide to new design if due allowance is made for the particular conditions met in each case.

The author is greatly indebted to George H. Fenkell, then General Manager and Chief Engineer of the Detroit Department of Water Supply for providing the opportunity to collect the data originally; to Seth M. Van Loan, Engineer in Charge of Water Works Improvement, Department of Public Works, Philadelphia, for the opportunity to make this review and revision; and to all the various plant officials, operators and designers who have contributed information and whose co-operation has made possible the tabulation of filter plant data that follows (Tables 1, 2, 3, 4).

Explanatory Notes

Most of the figures in these tables need no explanation, but, to make them more clear, a brief explanation of some of the items is given together with notes on characteristics which do not fall within the limits of the tabulation.

Capacity figures are given in U.S. gallons throughout.

The raw water characteristics given are those of the water entering the treatment plant.

Chemical feed is designated as "dry" when the chemical dosage is measured in a dry condition and as "solution" when the dosage is of a given concentration of chemical solution measured in a liquid form.

Velocity of mixing for a baffled mix is the rate of flow through the length of travel given; for the hydraulic jump at Cleveland, it is the velocity in the jump; for mechanical agitators it is the peripheral speed of the mixing paddle or blade; for tangential mix, no velocity is given.

The coagulation basin lengths and widths given are of the water surface, while the depths are either the range of water depth or the deepest water. Some peculiarities in shape are mentioned below.

The velocity in filter influent main or header is the maximum average cross-sectional velocity at nominal capacity flow.

The velocity in filter inlets is the velocity in the smallest cross-sectional area in the connection of filter to the influent main (or header) when the filter is operating at nominal capacity.

The dimensions of filters which are divided into two sand areas by a center wash gullet are indicated thus: 2 @ $a \times b$, where a is the width and b, the length of sand area, in each half.

Nominal capacity of plant is the product of the number of filter units and the size of units in million gallons per day.

Key to Table 1

(a) Also preliminary sedimentation
(b) Also storage on distribution system
(c) Impounded supply
(d) Data given under any date is for the portion constructed in that year
(e) Also has 48 pressure filters as follows: 36 with capacity of 0.5 mgd. and area of 175 sq.ft., and 12 with capacity of 0.25 mgd. and area of 87 sq.ft. (Hyatt)
(f) "Drifting sand" filters with cemented gravel
(g) Also around-the-end baffling
(j) Also secondary coagulation after settling
(k) Mixing also in 825-ft. conduit for 11.6 min. at 71 fpm. velocity
(m) No reservoir at filter plant; 39-mil.gal. reservoir on low service system; 12-mil.gal. reservoir on high service system
(n) Total population as of 1940 U.S. Census
(o) Also recarbonation
(p) Also aeration
(r) Also has a slow sand plant in operation

Types of Strainer Systems

A—Perforated brass plates over ridge and valley bottom
B—Manifold with perforated pipe laterals
C—Manifold with pipe laterals and brass strainers
D—Wagner bottom
E—Wooden slat grid
F—Wheeler bottom
G—Half-round cast-iron pipe raised ½ in. from floor leaving slot orifice between edge of pipe and floor
H—Perforated false bottom slab with strainers
I—Leopold bottom

TABLE 1

*Characteristics of Large Rapid Sand Filtration Plants in the U.S. and Canada, 1942**

	(1)	(2)	(3)	(4)		(5)		(6)	(7)
City	Akron, Ohio	Albany, N.Y.	Atlanta, Ga.	Baltimore, Md.		Birmingham, Ala.		Buffalo, N.Y.	Cambridge, Mass.
				Old Plant	New Plant	Shades Mt. Plant	Birm. Sta. Plant		
Population supplied (1940)	244,000	130,500	302,500	966,200		350,000		575,150	111,120
Date of beginning operation	1915	1931	1887	1915	1928	1904	1939	1926	1923
Date of enlargement	1919–22	—	1923 1938–40	—		1924–6–8	—	—	1932
Source of supply	Cuyahoga R.	Hannacrois & Basic Cr.	Chattahoochee R.	Gunpowder R.		Cahaba R.	M. Forks Black Warrior	L. Erie	Hobbs & Stony Br. & Fresh Pond Res.
Average analysis of raw water:	(c)	(c)	(c)	(c)		(c)	(c)		(c)
Turbidity, *ppm*	11–12	1.5	25–4400 Avg. 234	10–800		55	10	0–300	3
Alkalinity, *ppm*	60–72	43	7–24 Avg. 13.2	35		74	20	95	16
pH value—average	7–8	7.6	6.9	7.0		7.1	6.8	8.0	6.90
Color, *ppm*	45–49	13	0	5		0	5	0	35
Mixing chamber:		(p)							
Type of chemical feed	Dry & Solution	Dry	Dry	Solution		Solution	Solution	Dry	Dry
Alum added, *gpg*	1.90	1.5	0.59	0.8	0.8	0.60 0.55	0.50	0.2 to 0.9	1.4
Lime added, *gpg*	0.37	0	0.26	0.4	0.4		0.50	0	0
Mixing time at nominal capacity, *min*	2	20	23	36	30	6.5	25	0.8	1
Velocity at nominal capacity, *fpm*	90	60	64	78	78	4.5	5	90	20
Length of travel, *ft*	180	1200	1664	2800	2352	300	130	75	14
Type of baffling	Around end	Around end	Around end	Around end		Over & under	None	None	None
Type of mixing	Baffles	Baffles	Baffles	Baffles	Baffles	Mech. & Baffles	Rotary	Pumps	Conduit
Head loss in mixing, *ft*	1.5	3.0	0.8–1.3	3.3	3±	0.8–1.0	0.25	0	0
Sedimentation basins:									
Number of basins	6	3	4 @ 2, 2 @ 4 & 1 @ 5 mil.gal. (a)	2	2	1	2	2	2
Settling time at nominal capacity, *hr*	2.0	2.25	9.3	2.5	3.5	2.0	6	3.0	1.6
Velocity at nominal capacity, *fpm*	2.1	1.5	0.7	4.3	3.8	5.0	2.5	1.7	1.5
Method of baffling	Around end	Perf. brick wall		Around end		Slotted entrance	Slotted wall	Training walls	Perf. board entrance

Turbidity of settled water, *ppm*	6	0.5	13	5	5	10	5	20	4
Basins open or covered	Covered	Covered	Open	Open	Open	Open	Open	Covered	Covered
Length of one basin, *ft*	125.25	196	1 @ 400 2 @ 417	317	380±	535	150	304	137
Width of one basin, *ft*	54.33	50	1 @ 120 2 @ 100	232	1 @ 264± 1 @ 250±	432	50	202	48
Depth of one basin, *ft*	13	10–18	1 @ 24 2 @ 14	12.5 to 17	15± to 18±	18	14	24	16
Total basin capacity, *mil.gal*	4.5	3	21	13.5	1 @ 8 1 @ 8.6	80	1.5	20	1.5
Settled water conduits:									
Velocity—filter influent main, *fps*	1.0	1.38	3.42	2.0	0.65	3.4	1.9	4.0	1.33
Velocity—filter inlets, *fps*	2.25	1.0	1.48	1.97	1.97	2.2–2.8	3.0	2.84	1.33
Filters:			(e) 1923 1940						
Rate of filtration, *mgad*	125	125	125	125	125	125	125	125	137
Number of units	25	8	8 6	32	28	62	6	40	16
Size of units, *mgd*	2	4	3 5	4	4	38@ 0.5 24 @ 1	1	4	1.5
Dimensions of sand bed, *ft*	2 @ 12 x 29 2 @ 14 x 25	2 @ 15.25 x 46.5	2 @ 12.37 2 @ 19.5 x 42 x 44	2 @ 13 x 54	26 x 54	38 @ 15 dia. 24 @ 16 x 22	17.25 x 20.25	2 @ 14 x 50	24 x 20
Depth of filter box, *ft*	8.5	12.25	11	9	9	38 @ 10 24 @ 12±	7	9	9
Thickness of sand, *in*	30	30	24 27	24	24	30	30	26	27
Effective size of sand, *mm*	0.55	0.33	0.40 0.50	0.60±	0.60±	0.45	0.3–0.4	0.45	0.51
Uniformity coefficient of sand	1.29	1.75	1.65 1.6	1.2±	1.2±	1.5	1.35	1.5	1.54
Thickness of gravel, *in*	10	18	18 16	14	18	12	18	16	9
Maximum size of gravel, *in*	¾–1	2½	1½ ¾	3	3	1	2½	2½	1
Minimum size of gravel, *in*	⅛	⅛	¼ ⅛	¼	¼	¼	¼	⅛	½
Type of strainer system*	F	C	B D	A	E	H	B	B	F
Rate of wash, *in. rise per min*	21	24	30	24±	24±	22	24	24	20–27
Agitation of sand	No	No	No	No	No	No	No	Surf. wash	No
Height—top of sand to crest of trough, *in*	21	27	24	24	30	18 to 15	22	24	24
Clear distance between troughs, *ft*	4.47	4.67	3.25	4.85	3.92	5.75–3.25	4.25	4.25	2.50
Location of wash gullet	Center	Center	Center	Cent'r	Side	Front	Front	Center	Front
Wash water tank capacity, *1,000 gal*	70	252	400	248	242	106	156	240	175
Tank bottom above sand surface, *ft*	32.25	26.25	27	22.5	22.5	24.6	9	48	0
Percentage wash water—average	2.5–3	2.5	1.3	1.8	2.0	3.0	1.5	2.5	3.6 (p)
Filtered water reservoir:									
Open or covered	Covered	Covered	Covered	Covered	Open	Open	Covered	Covered	Covered
Capacity, *mil. gal*	1.6 (b)	2 (b)	10	15 (b)	6.4 19.4	3 43	0.25 6	18 (b) 160	4 (b) 24
Nominal capacity of plant, *mgd*	50	32	54	128	112				

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Continued**

	(8)	(9)	(10)	(11)		(12)	(13)	(14)	
City	Chattanooga, Tenn.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio		Columbus, Ohio	Dallas, Tex.	Denver, Colo. (r)	
				Division Plant	Baldwin Plant			Marston L. Plant	Moffat Plant
Population supplied (1940)	130,000	1,350,000	552,000	1,209,000		315,000	360,000	370,000	
Date of beginning operation	1887–92	—	1907	1918	1925	1908	1930	1925	1937
Date of enlargement	1913–18	—	1929	—		1923	1936–40	—	
	1926–31–41		1936–38						
Source of supply	Tennessee R.	L. Michigan	Ohio R.	L. Erie		Scioto R.	Trinity R.	South Platte R.	Headwater of Colorado R.
Average analysis of raw water:						(c)	(c)	(c)	
Turbidity, *ppm*	46	9	5–50 Avg. 18	0.2–200 Avg. 13.8	0.3–165 Avg. 9.8	70	30–2600 Avg. 180	2–40	10–52 Avg. 24
Alkalinity, *ppm*	60	120	15–65 Avg. 35	93	93	152	130	60–85	20–43 Avg. 31
pH value—average	7.4	8.0	6.4–8.4 Avg. 7.2	8.1	8.2	8.0	8.1	7.5–8.5	7.4–8.0 Avg. 7.6
Color, *ppm*	16	0	5–15	0	0	21	0	5–8	0
Mixing chamber:								(p)	
Type of chemical feed	Solution	Dry	Dry	Solution	Solution	Solution	Dry	Dry	Dry
Alum added, *gpg*	1.13	0.4	1.10 $FeSO_4$	0.5–2.5	0.5–2.5	1.9	1.0 $FeSO_4$	0.1–1.0	0.6–1.3 Avg. 0.91
Lime added, *gpg*	0.02	—	0.85	0	0	$9.2Ca(OH)_2$ $3.7NaCO_3$	5.2	0.05–0.50 $Na_2Al_2O_4$	0.22
Mixing time at nominal capacity, *min.*	15	2 Rapid 50 Slow	1 Initial 60 Slow	39	1	60	12	20	7.5
Velocity at nominal capacity, *fpm*	37	—	60	21	600 to 700	88	150	20	8
Length of travel, *ft*	75	700	120	820	30 and 325	5280	1800	400	100
Type of baffling	—	—	4 Underflow	Over and under (g)	Over and under	Over and under	Around end	Around end	None
Type of mixing	Conduit	Mech.	Hydr. jump & mech.	Baffles	Hydr. jump	Baffles & mech.	Baffles	Baffles	Conduit velocity
Head loss in mixing, *ft*	—	—	2.0	0.4	2.4	3.3 @ 30 mgd.	1.5	0.5	—
Sedimentation basins:									
Number of basins	3	3	2 (a)	6	4	6	4	1	3
Settling time at nominal capacity, *hr*	3.7	3.7	2.75	3.4	4.67	6.67	8	1.0	4.8
Velocity at nominal capacity, *fpm*	0.8	2.2	2.15	2.8	2.4	2.5	1.1	12.0	1.2
Method of baffling	None	Slotted entrance	None	Around end	None	Around end	None	None	Around end

Turbidity of settled water, *ppm.*	10	—	3–8, Avg. 4	2.2	1.7	1	5–25	3–45	5
Basins open or covered	Open	Covered	Open	Covered	Covered	Open	Open	Open	Covered
Length of one basin, *ft.*	175	480	350	227.5	693	200	2 @ 148 2 @ 407	174.33	290
Width of one basin, *ft.*	2 @ 75 1 @ 120	138	175	142	110.25	100	2 @ 148 2 @ 166	166.67	90
Depth of one basin, *ft.*	15	32	20	16.92–17.25	9.25–18.5	20	18	13.42	14.33
Total basin capacity, *mil gal.*	2 @ 1.3 1 @ 2.3	49	18.4	21	32.8	15	16	2.0	10
Settled water conduits:		(o)	(o)			(o)			
Velocity—filter influent main, *fps.*	3.1–7.2	0.6	2.0	2.2	2.17	2.0	2.9	2.0	2.8
Velocity—filter inlets, *fps.*	1.4–2.8	1.5	2.0	2.94	2.04	0.65	1.2	1.7	2.4
Filters:									
Rate of filtration, *mgad.*	125	125	125	125	125	125	120	156	150
Number of units	26	80	40	36	40	18	24	14	10
Size of units, *mgd.*	20 @ 1 6 @ 2	4	4	4.16	4.16	3	2	4.5+	5
Dimensions of sand bed, *ft.*	20–16 x 22 6–2 @ 16 x 22	25.75 x 50	2 @ 14 x 50	2 @ 14 x 50	2 @ 14.83 x 49	2 @ 11.5 x 47	2 @ 13 x 28	23 x 54.33	2 @ 19 x 36.67
Depth of filter box, *ft.*	9	13.5	10.33	13.58	13.50	11	10.75	11.75	10
Thickness of sand, *in.*	30	24	27	24–27	25.5	24	30	48 (coal)	27
Effective size of sand, *mm.*	0.42	0.50	0.44	0.48	0.38	0.55	0.40–0.45	0.62	0.48
Uniformity coefficient of sand	1.5	1.5	1.50	1.50	1.70	1.60	1.60	1.78	1.41
Thickness of gravel, *in.*	15	20	18	22–25	22	18	18	15	24
Maximum size of gravel, *in.*	1	2½	2½	1½	1½	2½	2½	¾	2½
Minimum size of gravel, *in.*	¼	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	⅛	¼	$\frac{1}{16}$	¼
Type of strainer system*	H in 20 B in 6	—	B	B	B	A in 10 B in 8	B	B	B
Rate of wash, *in. rise per min.*	20–25	15–24	20–25	24–29	24–36	24	20	25	27
Agitation of sand	No	Surf. wash	No	No	No	No	No	Air	No
Height—top of sand to crest of trough, *in.*	18–20	26	26	26–30	30	24	24	48	27
Clear distance between troughs, *ft.*	8 @ 5.5 12 @ 3.0	4	3.5	6.0	4.93	6.0	5.0	9.33	2.92
Location of wash gullet	Fr./Cen.	Side	Center	Center	Center	Center	Center	Side	Center
Wash water tank capacity, *1,000 gal.*	212	300	843	460	2 @ 212	104	0	150	230
Tank bottom above sand surface, *ft.*	6	57.5	35	35	44.1	20.17	—	39.5	40
Percentage wash water—average	1.52	—	1.25	2.49	2.03	1.0	1.5	1.4	1.44
Filtered water reservoir:									
Open or covered	Open	Covered	Covered	Covered	Covered	Covered	Covered	Covered	Covered
Capacity, *mil.gal.*	1.3 (b)	50	20 (b)	19.6 (b)	20 (b)	16 (b)	5 (b)	6	10
Nominal capacity of plant, *mgd.*	32	320	160	150	165	54	48	64	50

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Continued**

	(15)		(16)		(17)	(18)	(19)	(20)		(21)
City	Detroit, Mich.		Erie, Pa.		Evansville, Ind.	Flint, Mich.	Ft. Wayne, Ind.	Ft. Worth, Tex.		Grand Rapids, Mich.
	Water Wks. Pk. Plant	Spring-wells Plant	Chestnut St. Plant	West Plant						
Population supplied (1940)	1,900,000		124,000		112,000	155,000	118,000	177,662 (n)		164,000
Date of beginning operation	1923	1931	1914	1932	1912	1913	1933	1912		1912
Date of enlargement	1928	—	1925	—	1924–31–39	1918–24 1939	—	1918–23–32		1924–30 1940
Source of supply	Detroit R.		L. Erie		Ohio R.	Flint R.	St. Joseph R.	L. Worth		L. Michigan
Average analysis of raw water:							(c)	(c)		
Turbidity, *ppm.*	5–500 Avg. 22		20–400		15–1400 Avg. 147	30	77	37		9
Alkalinity, *ppm.*	83		92		57	220	209	122		100
pH value—average	8.1		7.6		8.2	8.0	7.7	8.0		8.0
Color, *ppm.*	0		10		0	49	40	5		0
Mixing chamber:						(p)	(p)	(p)		
Type of chemical feed	Dry	Dry	Solution	Dry	Dry	Dry	Dry	Dry		Solution
Alum added, *gpg*	0.74	0.6	0.2	0.2	1.80	1.1	0.47	0.94		0.5
Lime added, *gpg*	0	0	0	0	0.83	12.8	13.2	0.59		0
Mixing time at nominal capacity, *min.*	3	17	10	40	10	2 Rapid 60 Slow	5 Rapid 60 Slow	38	20	30
Velocity at nominal capacity, *fpm*	80	60	6.5	36	30	36	170 Rapid 54 Slow	44	70	100
Length of travel, *ft.*	240	1020	65	—	—	—	40	1196	—	3000
Type of baffling	Around end	Around end	Over & under	None	Over & under	Over & under	—	Around end	—	Around end
Type of mixing	Baffles & pumps	Mech. & baffles	Baffles	Mech.	Baffles & Mech.	Baffles & air	Mech.	Baffles	Mech. mix	Baffles
Head loss in mixing, *ft.*	1±	—	1.3	0	1.0	0.7	0	1±	0.5	1.0
Sedimentation basins:										
Number of basins	2	4	2	2	5	3	2	4		4
Settling time at nominal capacity, *hr.*	2.0	2.25	2.5	6	4.5	6.0	4	6		2.5
Velocity at nominal capacity, *fpm*	4.2	2.5	1.2	1	3	2 @ 2–3 1 @ 3–4	2	2 @ 2.2 1 @ 2.0 1 @ 1.8		1.6
Method of baffling	Around end & distr. vanes	Slotted entrance & guide vanes	Around end	None	4 Around end & 1 Over & under	Around end	Walls	Around end		Around end

Turbidity of settled water, *ppm*	11	10–15	2–20	2–20	9.1		10–15	—	8	20
Basins open or covered	Covered	Covered	Covered	Covered	Covered		Covered	Covered	Open	2—Open 2—Covered
Length of one basin, *ft*	505	338.83	182	164	100		2 @ 175 1 @ 220	84	2 @ 130 1 @ 173 1 @ 308	118.75
Width of one basin, *ft*	240	135.5	51	78	Varies (about 50)		2 @ 100 1 @ 140	84	2 @ 85 1 @ 96 1 @ 138	88.5
Depth of one basin, *ft*	16	18	24	22	28.5		2 @ 14.5 1 @ 13.5	12	2 @ 15.5 2 @ 15	13.5
Total basin capacity, *mil.gal*	29	25	3.33	4	4.5		7	3.6	8.75	4
Settled water conduits:							(o)	(o)		
Velocity—filter influent main, *fps*	3.8	0.9	—	—	0.6		1.0–3.0	1.22	2.5–3.2	2.5
Velocity—filter inlets, *fps*	1.97	0.88	—	—	1.5		2.0	—	1.1–1.8	2.2
Filters:					(d) 1924–39	(d) 1931				
Rate of filtration, *mgad*	160	160	125	125	125	130	125	125	120	118
Number of units	80	68	16	8	8	12	28	10	12 / 1.25	20
Size of units, *mgd*	4	4	2	2	1.5	1	1	2.5	10 / 2	2
Dimensions of sand bed, *ft*	32 x 34	27 x 40.33	712.5 sq.ft.	712.5 sq.ft.	21 x 25	16 x 21	16 x 22.5	28 x 24	2 @ 9 x 25 / 2 @ 13.25 x 28.67	20.5 x 36 20.5 x 42
Depth of filter box, *ft*	10.5	11	10	10	8.5	8.28	7	14	7 / 8	8
Thickness of sand, *in*	30	20	27	27	28	20	27	24	27 / 27	30
Effective size of sand, *mm*	0.45	0.54	0.40	0.45	0.44	0.44	0.45–0.50	0.45	0.37 / 0.46	0.5
Uniformity coefficient of sand	1.60	1.52	1.7	1.6	1.5	1.5	1.3–1.4	1.2	1.86 / 1.60	1.33
Thickness of gravel, *in*	17	18	12 @ 6 4 @ 18	14	24	18	12	16	18 / 18	15
Maximum size of gravel, *in*	2	3	2½	1	2½	2½	2	2	1½ / 1½	2½
Minimum size of gravel, *in*	1/16	1/16	3/16	¼	¼	¼	4 mesh	3/16	3/16 / 3/16	1/16
Type of strainer system*	C	B	H in 4 I in 12	H	B	B	C	B	B / B	A in 15 D in 5
Rate of wash, *in. rise per min*	26–30	30–36	12–15	12–15	24	24	16	24–40	19–20 / 23–24	23
Agitation of sand	No	No	Surf. wash	Surf. wash	No	No	No	No	No / No	No
Height—top of sand to crest of trough, *in*	30	40	33	33	24	22	16	24	24 / 36	15
Clear distance between troughs, *ft*	5.83	4.44	5.5	5.5	4.0	4.5	3.17	5.0	5.0 / 5.0	4.0
Location of wash gullet	Front	Front	Center	Center	Front	Front	Front	Front	Center / Center	Side
Wash water tank capacity, *1,000 gal*	140	95	113	110	144		—	100	200	200
Tank bottom above sand surface, *ft*	29	35.5	75	38.67	8		34.5	39	17.5	22
Percentage wash water—average	2.0	1.3	1.75	1.75	3.0		2.0	1.64	1.75	1.5
Filtered water reservoir:										
Open or covered	Covered	Covered	Open	Covered	Covered		Covered	Covered	Covered	Covered
Capacity, *mil.gal*	55 (b)	40 (b)	1 (b)	0.5 (b)	1.9 (b)		10 (b)	20	5	8.5 (b)
Nominal capacity of plant, *mgd*	320	272	32	16	24		28	25	35	40

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Continued**

City	(22) Hamilton, Ont.	(23) Indianapolis, Ind. (r) White R. Plant	(23) Indianapolis, Ind. (r) Fall Cr. Plant	(24) Kansas City, Kan.	(25) Kansas City, Mo.	(26) Knoxville, Tenn.	(27) Louisville, Ky.	(28) Miami, Fla.
Population supplied (1940)	155,000	386,000		121,000	400,000	111,580 (n)	319,077 (n)	172,172 (n)
Date of beginning operation	1933	1926	1941	1909	1928	1927	1909	1926
Date of enlargement	—	—	—	1912–27	—	—	1914–28–29–31	1936
Source of supply	L. Ontario	White R.	Fall Cr.	Missouri R.	Missouri R.	Tennessee R.	Ohio R.	Wells
Average analysis of raw water:		(c)	(c)					
Turbidity, *ppm*	5–500	29	16	100–20000 Avg. 2040	100–20000 Avg. 2000	132	5–5500 Avg. 185	0
Alkalinity, *ppm*	98–100	230	235	143	159	62	55	230
pH value—average	7.8–8.3	7.9	7.95	8.2	8.0	7.7	6.7–8.5	(Hardness 272)
Color, *ppm*	0	33	25	26	13	23	0	50
Mixing chamber:								(p)
Type of chemical feed	Dry	Solution	Dry	Solution	Solution	Dry	Dry	Solution
Alum added, *gpg*	0.5	1.5	1.47	1.12	1.20	2.30	0.65	1.0
Lime added, *gpg*	—	0	—	0.49	0.57	—	0.31 added after filtration	11.0
Mixing time at nominal capacity, *min*	1 Rapid 30 Slow	9.6	2 Rapid 40 Slow	10	30	21		15
Velocity at nominal capacity, *fpm*	60	156	60	65	Two 90' diam. tangential mixing chambers	120	No mixing chamber	60
Length of travel, *ft*	60	1500	—	650		—		—
Type of baffling	None	None	—	Around end		None		None
Type of mixing	Mech.	Conduit	Mech.	Baffles		Mech.		Mech.
Head loss in mixing, *ft*	0	0	0	0.4	3.5	1.4		2 (p)
Sedimentation basins:								
Number of basins	2	1	4	3 (a)	5 (a)	2	3 (a)	2 Clarif. 1 Settling
Settling time at nominal capacity, *hr*	3	2.0	2.33	33	12.5	8.9	2.0	2 Clarif. 1 Settling
Velocity at nominal capacity, *fpm*	1.2	2.5	2.1	2.5	0.6	0.4	5.7	0.9 Clarif. 2 Settling
Method of baffling	None	None	None	None	None	Fence of slats at inlet	Around end	Under baffle at inlet

Turbidity of settled water, *ppm*	2–20	1.6	1	22	33	6.6	25		1
Basins open or covered	Covered	Open	Covered	Open	Open	Open	Open		Open
Length of one basin, *ft*	264	230	191	201	3 @ 309 2 @ 254	175.5	340.5		109 Clarif. 120 Settling
Width of one basin, *ft*	111	85	16	304	3 @ 333 2 @ 259	1 @ 143 1 @ 51	80.5		109 Clarif. 60 Settling
Depth of one basin, *ft*	14.5	13.5	15.7	21–25	17	25	17.5		17
Total basin capacity, *mil.gal*	6 *	1	0.5	34	52	5	10		1.5 Clarif. 0.9 Settling
Settled water conduits:							0.11		(o) 1.0
Velocity—filter influent main, *fps*	1.3	1.17	1.64	3.0	2.5	3.05	2.3		2.75
Velocity—filter inlets, *fps*	1.5	0.775	1.27	1.0	2.84	2.75			
Filters:				(d) 1912 / (d) 1927			(d) 1931	(d) 1914	(d) 1928
Rate of filtration, *mgad*	120	120	123	125	125	125	125	125	125	125
Number of units	12	6	6	9 / 5	24	6	6	12	8	16
Size of units, *mgd*	4	2	2.66	1.37 / 2.74	4	2.5	6	3	6	2.5
Dimensions of sand bed, *ft*	32 x 45	20.75 x 34.75	30.5 x 30.83	16 x 30 / 2 @ 16 x 30	2 @ 14 x 50	2 @ 13.1 x 33.5	52.67 x 40.5	23 x 47	42 x 50	2 @ 10 x 43.75
Depth of filter box, *ft*	10	10.08	8.83	10.83	10.83	9.75	10	10	10	11
Thickness of sand, *in*	30	30	27	26	24	27	30	26	30	30
Effective size of sand, *mm*	0.44	0.45	0.39	0.39	0.43	0.42	0.47	0.41	0.42	0.50	0.45
Uniformity coefficient of sand	1.5	1.2	1.4	1.62	1.51	1.55	1.68	1.30	1.30	1.30	1.45
Thickness of gravel, *in*	20	24	19	14	18	18	24	24	14	24	8 @ 34 8 @ 12
Maximum size of gravel, *in*	2½	3	2	2	2½	2	1½	2	1½	2	1–2½
Minimum size of gravel, *in*	⅛	⅛	⅛	⅛	⅛	¼	¼	⅛	⅛	⅛	⅛
Type of strainer system*	B	B	H	A	B	B	B	C	B	B in 8 F in 8
Rate of wash, *in. rise per min*	28–38	24	30	24	24	24–30	22–36	22–36	22–36	26
Agitation of sand	No	Surf. wash	Surf. wash	No	No	No	No	Surf. wash			No
Height—top of sand to crest of trough, *in*	42	22	24	27	24	24	24	25	24	25
Clear distance between troughs, *ft*	5.0	3.62	4.58	4.79	4.79	4.33	5.0	5.08	5.17	6.5	5.0
Location of wash gullet	Center	Front	Center	Side	Center	Center	Center	Center	Front	Center	Center
Wash water tank capacity, *1,000 gal*	202	125	150	100		150	150	125		300	100
Tank bottom above sand surface, *ft*	32.5	20	30	40		22	38	42		37	22
Percentage wash water—average	2	2.2	2.1	2.0		1.37	1.74	2.0			1.2
Filtered water reservoir:											
Open or covered	Covered	Covered	Covered	Covered		Covered	Covered	Covered			Covered
Capacity, *mil.gal*	2	15.5	7.5	1 (b)		3 (b)	0.5 (b)	20 (b)			5 (b)
Nominal capacity of plant, *mgd*	48*	12	16	26		96	15	120			40

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Continued**

	(29)	(30)		(31)	(32)	(33)		(34)		(35)		
City	Milwaukee, Wis.	Minneapolis, Minn.		Montreal, Que.	Nashville, Tenn.	New Orleans, La.		Norfolk, Va.		Oakland, Calif.		
		Columbia Heights Plant	Fridley Plant					Moore's Bridges Plant	Lake Prince Plant	San Pablo Plant	San Leandro Plant	Orinda Plant
Population supplied (1940)	651,000	492,000		1,400,000	242,000	494,537 (n)		144,332 (n)		560,000		
Date of beginning operation	1939	1913	1927	1918	1929	1909		1899	1923	1921	1927	1935
Date of enlargement	—	1914–20	1928	1927–30–36	1932	1924–31		1921	—	1930	1930	—
Source of supply	L. Michigan	Mississippi R.		St. Lawrence & Ottawa R.	Cumberland R.	Mississippi R.		Four Lakes	L. Prince	Mokelumne R.		
Average analysis of raw water:												
Turbidity, *ppm*	Avg. 2	2–95 Avg. 6.8		15	5–590 Avg. 65	75–2350 Avg. 700		45 (e)	18.5 (e)	16 (e)	13 (e)	3 (e)
Alkalinity, *ppm*	110	80–210		65	36–123 Avg. 75	93 Avg.		41.6	45.8	102	117	26
pH value—average	8.1	7.5		7.5	7.5	7.4–8.2		7.0	7.15	8.1	7.7	7.0
Color, *ppm*	0	20		18	1	12		67	50	20	5	0
Mixing chamber:			(p)		(p)	(d)	(d)			(p)	(p)	(p)
Type of chemical feed	Dry	Dry	Dry	No mixing chamber	Dry	1909 Solution	1926–28 Solution	Alum-solution Lime-dry		Dry	Dry	Dry
Alum added, *gpg*	0.5	0.15–6.5	0.15–6.5		1.01	0.75 $FeSO_4$	0.75 $FeSO_4$	1.49	1.56	0.66	0.6	0.30
Lime added, *gpg*	0.11	0	0		0.35	4.98	4.98	0.69	0.49	0.3	0.5	0.06
Mixing time at nominal capacity, *min.*	4 Rapid 60 Slow	3	6		26	60	60	1	10	8	16	12
Velocity at nominal capacity, *fpm*	70	49	29		48	85	84	60	40	90	120	43
Length of travel, *ft*	74	120	118		60	5120	5056	60	400	720	—	500
Type of baffling	—	Over & under	Over & under		None	Over & under (g)	Around end	Over & under	Over & under (g)	Over & under	None	Over & under
Type of mixing	Conduit & Mech.	Baffles			Mech.	Baffles		Baffles		Baffles	Mech.	Baffles
Head loss in mixing, *ft*	0	0.75	0.75		0.1±	1.5±	1±	—	—	1.5	0.2	1.0
Sedimentation basins:									(p)			
Number of basins	2	6 (a)	4	tion basins	2 (a)	4 (a)	4 (a)	2	2	2	2	—
Settling time at nominal capacity, *hr.*	4	2.4	4.6		2.1	18	16	4.5	5.0	3.0	2.7	—
Velocity at nominal capacity, *fpm*	2.32	1±	3.5		1.5	0.55	0.52	1.5	1.5	1.67	1.1	—
Method of baffling	—	Around end	Around end		None, perf. inlet	Around end	Around end	Slotted wall	Around end	Diffuser wall	Diffuser wall	—

Turbidity of settled water, *ppm*	0.6	4	4	No coagula-	4	13	13	9	6	2	5	—
Basins open or covered	Covered	Covered	Covered		Open	Open	Open	Open	Open	Open	Open	—
Length of one basin, *ft.*	300	4 @ 131.5± 2 @ 120.8	192.5		188	345	380	400	230	300	200	—
Width of one basin, *ft.*	297	2 @ 193.3 4 @ 95.67	167		75	250	368	75±	74	50	50	—
Depth of one basin, *ft.*	27	16	16		17.75	13.75	13.75	12±	10	13	13	—
Total basin capacity, *mil.gal.*	11	7.8	15.6		3.75	30	47	3	2.5	3	2	—
Settled water conduits:				—								
Velocity—filter influent main, *fps.*	1.37	3.0	1.4		3.3	1.55	1.37	4.73	1.5 to 2.5	1.0	0.75	0.3
Velocity—filter inlets, *fps.*	1.8	2.3	1.96	2.8	1.66	2.85	2.85	1.9	3.0	1.16	1.16	2.03
Filters:												
Rate of filtration, *mgad.*	125	125	125	136	125	122	122	136	125	108	108	125
Number of units	32	24	20	48	18	10	18	22	12	16	12	16
Size of units, *mgd.*	6.25	3.25	4	3.75	2.33	4	4	18 @ 0.67 4 @ 1	1	1.5	1.5	1.75
Dimensions of sand bed, *ft.*	2 @ 19 x 57	2 @ 11.5 x 5	35 x 40	2 @ 12 x 50	25 x 33	2 @ 13.5 x 53	2 @ 13.5 x 53	11.5 x 18.5	16 x 22	20.3 x 30	14 x 44	30.3 x 20.3
Depth of filter box, *ft.*	10	10	10	10	8.75	12	13	8	9	11.5	11.5	11
Thickness of sand, *in.*	27	30	30	30	30	30	36	30	30	30	30	30
Effective size of sand, *mm.*	0.51	0.35–0.44	0.40–0.5	0.48	0.40	0.33	0.5	0.49	0.38	0.5	0.6	0.54
Uniformity coefficient of sand	1.32	1.65	1.55	1.65	1.65	1.65	1.3	1.59	1.63	1.39	1.5	1.58
Thickness of gravel, *in.*	24	17	18	15	18	9	7–10	15	15	18	18	22
Maximum size of gravel, *in.*	2½	3	2½–2¾	1½	2½	¾	2	2½	2½	1¼	1¼	1¼
Minimum size of gravel, *in.*	1/16	1/16	1/16	1/16	10 mesh	⅛	⅛	½	½	½	½	1/16
Type of strainer system*	D	A	B	B	H	A	B	B & C	H	B	B	B
Rate of wash, *in. rise per min.*	24	18	18–24	16	24	24	24	24	24	30	24	36
Agitation of sand	Surf. wash	No	No	Air	No	No	No	No	No	No	No	No
Height—top of sand to crest of trough, *in.*	27	24	25	17	24	33	30	26–28	26–28	24	30	35
Clear distance between troughs, *ft.*	7.125	5.0	4.0	5.0	5.0	6.62	6.62	4.17	3.5	5.0	5.0	4.0
Location of wash gullet	Center	Center	Front	Center	Center	Center	Center	Front		Side	Side	Side
Wash water tank capacity, *1,000 gal.*	750	125	132	248	200	120		0	27	80	80	200
Tank bottom above sand surface, *ft.*	53	35	36	28.75	63	19.5		—	15.5	40.5	39	42.75
Percentage wash water—average	2.2	1.58	1.40	0.5	1.75	0.3		3.38	1.42	1.6	2.24	1.91
Filtered water reservoir:												
Open or covered	Covered	Covered		Covered	Covered	Covered		Open	Covered	Covered	Covered	Covered
Capacity, *mil.gal.*	30	45	16.5	30 (b)	1.3 (b)	20		2.5	3	6 (b)	3 (b)	9 (b)
Nominal capacity of plant, *mgd.*	200	78	80	180	42	40	72	16	12	24	18	28

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Continued**

	(36)	(37)	(38)	(39)	(40)		(41)	(42)
City	Oklahoma City, Okla.	Omaha, Neb.	Ottawa, Ont.	Paterson, Passaic & Little Falls, N.J., Dist.	Philadelphia, Pa. (r)		Providence, R.I.	Reading, Pa.
					Queen Lane Plant	Belmont Plant		
Population supplied (1940)	204,424 (n)	223,844 (n)	165,116	550,000	1,931,334 (n)		335,000	110,568 (n)
Date of beginning operation	1906	1923	1932	1902	1922	1929	1926	1935
Date of enlargement	1923	1932	—	1919	1925–26	—	1940	—
Source of supply	North Canadian R.	Missouri R.	Ottawa R.	Passaic R.	Schuylkill R.		Scituate Res.	L. Ontelaunee
Average analysis of raw water:								
Turbidity, *ppm*	(c) 20–400 Avg. 100	150–22000	10	(c) 3	74–251		(c) 1	15
Alkalinity, *ppm*	30–250 Avg. 150	95–220	20	31	49		4	78
pH value—average	8.0	7.8	7.0	7.2	7.3		6.9	7.9
Color, *ppm*	85	10±	45	37	9		13	13
Mixing chamber:	(p)						(p)	
Type of chemical feed	Alum—soln. Lime—dry	Alum—soln. Lime—dry	Dry	Dry	Solution		Dry	Solution
Alum added, *gpg*	0.36	0.25–4.25	2.0	1.5	1.28	1.12	0.34	1–1.5
Lime added, *gpg*	8.0	0-1	0.7	0	0	0.20	$FeCl_3$ 0.55	—
Mixing time at nominal capacity, *min.*	30	8.5	40	No mixing chamber	No mixing chamber	30	4.7 (k)	27
Velocity at nominal capacity, *fpm*	36	120	60			4.1	One 35′ diam. tangential mixing chamber (k)	19
Length of travel, *ft.*	1080	900	—			123		750
Type of baffling	Over & under Baffles	Around end Conduit & Baffles	None Spiral flow			Over & under Baffles		Around end Baffled channels
Type of mixing								
Head loss in mixing, *ft.*	2.0	1.0	0.5			0.5	1.0	0.3–0.4
Sedimentation basins:								
Number of basins	4	6 (a)	3	2	4 (a)	2 (a)	2	3
Settling time at nominal capacity, *hr.*	4.0	2.7	3.33	4.3	3.8	2.1	60	6.6
Velocity at nominal capacity, *fpm*	0.83	1.3	1.0	3±	1.2	1.2	0.9	0.93
Method of baffling	Slotted inlet	Vertical baffles	None	(d) 1902 Around end / (d) 1919 None	Submerged inlet wall	None	Around end	Perf. brick wall

					2				
Turbidity of settled water, *ppm*	12	24	5	Open	Covered	4	9	0.5	0.5
Basins open or covered	Open	Open	Covered	310	144	Open	Open	Open	Open
Length of one basin, *ft.*	190	380	301			290	150–170	1 @ 800 1 @ 1300	200
Width of one basin, *ft.*	2 @ 40 2 @ 50	370	29.67	110	44	80	115–80	1 @ 550 1 @ 850	100
Depth of one basin, *ft.*	12	35	29	20	43	12.25	11.3	1 @ 15 1 @ 18	10.5–13.67
Total basin capacity, *mil.gal.*	2.67	80	6	5.7	1.8	8	3.4	1 @ 43.4 1 @ 111.4	5.4
Settled water conduits:	(o) (j)								
Velocity—filter influent main, *fps*	1.97	1.2	1.2	1.3	0.4	1.0	0.3	1.2	0.93
Velocity—filter inlets, *fps*	2.0	2.0	1.5	2.0	2.0	2.2	2.3	1.1	1.93
Filters:									
Rate of filtration, *mgad*	120	125	125	120	125	95	100	110	125
Number of units	8	18	10	32	10	20	12	14	6
Size of units, *mgd*	2	4	4.2	1	1	2.5	2.5	4.4	3.33
Dimensions of sand bed, *ft.*	2-12 x 30	2 @ 14 x 50	26 x 56	15 x 24	348 sq.ft.	2 @ 14.5 x 40	44 x 25	2 @ 16 x 55	41.5 x 28.17
Depth of filter box, *ft.*	10±	8	6.67	10	12	9	10	10.5	11
Thickness of sand, *in.*	24	24	34	30	30	30	28	30	21
Effective size of sand, *mm.*	0.37–0.42	0.50	0.47	0.44–0.47	0.45–0.50	0.40–0.50	0.40–0.55	0.42	0.45
Uniformity coefficient of sand	1.60	1.75	1.39	1.40	1.40	1.50–1.70	1.50–1.70	1.48	1.6
Thickness of gravel, *in.*	18	9	20	12	15	18	18	18	28
Maximum size of gravel, *in.*	2½	1½	1½	2	3	3	2	2	2½
Minimum size of gravel, *in.*	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛
Type of strainer system*	B	D	B	C	F	B	E	B	B
Rate of wash, *in. rise per min.*	24	24	30	12	27	12–15	24–30	18–27	40
Agitation of sand	No	No	No	Air	No	Air	No	No	No
Height—top of sand to crest of trough, *in.*	26	22	26	14	24	15	22	24	22
Clear distance between troughs, *ft.*	4.62	3.42	5.56	3.0	2.1	3.5 & 4.1	4.25	2.83	4.92
Location of wash gullet	Center	Center	Side	Front		Center	Side	Center	Center
Wash water tank capacity, *1,000 gal.*	100	300	250	20		200	59	400	225
Tank bottom above sand surface, *ft.*	40	30.6	14.75	58		34	19	23	57
Percentage wash water—average	2.1	1.4	1.56	2.2		1.0	3	0.8	1.0
Filtered water reservoir:	(p)							(p)	
Open or covered	Covered	Open	Covered	Covered		Covered		Covered	Covered
Capacity, *mil.gal.*	3.5 (b)	20	6	3.5 (b)		50	1 (b)	0 (m)	10
Nominal capacity of plant, *mgd.*	16	72	42	42		50	30	61.6	20

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Continued**

	(43)	(44)	(45)		(46)	(47)	(48)		(49)	
City	Richmond, Va.	Sacramento, Calif.	St. Louis, Mo.		St. Paul, Minn.	Tampa, Fla.	Toledo, Ohio		Toronto, Ont. (r)	
			Chain of Rocks Plant	Howard Bend Plant			Old Plant	Lake Plant	Island Plant	Victoria Pk. Plant
Population supplied (1940)	225,000	105,958 (n)	490,000	335,000	287,736 (n)	108,391 (n)	350,000		1916	648,100
Date of beginning operation	1924	1924	1915	1929	1923	1926	1910	1942	—	1941
Date of enlargement	—	1927, 1932	—	—	1939	—	1913–21–22	—	—	—
Source of supply	James R.	Sacramento R.	Mississippi R.	Missouri R.	Mississippi R.	Hillsborough R. (e)	Maumee R.	L. Erie	L. Ontario	
Average analysis of raw water:										
Turbidity, *ppm*	0–2000	64	1430	1900	4	1–5	190	125	1,200 Avg. 6	1–200
Alkalinity, *ppm*	46	57	132	138	152	95	142	91	96	96
pH value—average	7.4–8.1	7.4	7.95	8.05	8.2	7.3	7.8	7.5	7.5–8.4 Avg. 7.8	7.5–8.4
Color, *ppm*	38	—	25	15	27	96	35	10	0	0
Mixing chamber:		(p)			(p)					
Type of chemical feed	Dry	Solution	Solution	Dry	Dry	Dry	Alum—soln. Lime—dry	Dry	Solution	Dry
Alum added, *gpg*	2	1.5	1.2 $Al_2(SO_4)_3$ 1.0 0.73 $FeSO_4$ 0.5		0.7	0.3–6.5	2.58	1.25	0.4	0.25
Lime added, *gpg*	0	0	4.7	6.0	6.8	1.0–6.5	0.5	0.4	0	0
Mixing time at nominal capacity, *min*	10	80	45	16	70	30	30	45	2±	40
Velocity at nominal capacity, *fpm*	45	180	106		16–60	—	40	1.5	78–630	179
Length of travel, *ft*	450	—	4760		130	—	1243	234	417 in pipe	—
Type of baffling	Over & under	None	Around end	Tangential mixing chambers	Over & under	Center down baffle	Around end	Around end	None	None
Type of mixing	Baffles & Mech.	Mech.	Baffles		Air, Baffles & Mech.	Baffles	Baffles	Mech.	Pumps & conduit	Spiral flow
Head loss in mixing, *ft*	1.4	1	2.5	0.5±	0.17	0.1±	2.0	—	0	0.5
Sedimentation basins:										
Number of basins	4 (a)	9 (a)	6 (a)	2 (a)	2 Primary (a) 2 Second.	4	3	4		3
Settling time at nominal capacity, *hr*	10	0.5 Primary 1.0 Second.	36	8.7	2 Primary 3.8 Second.	2.0 Primary 6.0 Second.	8.0	3		2.83
Velocity at nominal capacity, *fpm*	6.0	2 Primary 4 Second.	1.5	2.3±	3	0.5 Primary 1.5 Second.	1–2	1.5		1.8
Method of baffling	—	None	Series basins & weirs	None	Around end in second. basins	Around end (second.) mix baffles in 2 basins	2 Around end 1 straight flow, perf. inlet	—	tion basins	None

Turbidity of settled water, *ppm*	8	3	9	5	5	5–10	12	6	No coagula-	Covered
Basins open or covered	Open	Open	Open	Open	Primary—open Second.—cov.	Open	Covered	Covered		
Length of one basin, *ft*	320	100 Primary 145 Second.	400	330	220	108	500	270.4		310
Width of one basin, *ft*	120	100 Primary 44 Second.	670	406	110 110	78	2 @ 100	83.3		88
Depth of one basin, *ft*	10	10 Primary 9 Second.	15.9–23	15	15–19	15	1 @ 120 18	15		22
Total basin capacity, *mil.gal*	7.5	10	240	29	11.6	3.7	19	10		13.5
Settled water conduits:			(j)	(o) (j)	(o)	(o) (j)			2.6	3.0
Velocity—filter influent main, *fps*	1.29	1.23	1.36–2.53	1.94	2.2	1.9	2.4	1 2	6″ = 1.26	2.0
Velocity—filter inlets, *fps*	2.61	0.86	2.87	1.42	2.48	1.9	20	1 26	12″ = 2.36	
Filters:										
Rate of filtration, *mgad*	120	125	125	125	125	125	125	125	180	126
Number of units	10	16	40	20	15	8	56	40	10	20
Size of units, *mgd*	3	4	4	4	3.5	1.75	1	2	7.2	6
Dimensions of sand bed, *ft*	2 @ 12.25 x 44	1440 sq.ft.	2 @ 14 x 50	28 x 50	2 @ 14.5 x 42.25	2 @ 10 x 30	16 x 22.5	14.33 x 49.83	1745 sq.ft.	2 @ 15.5 68
Depth of filter box, *ft*	9	13	10.5	13.5	11.25	8.5	8.5		14	9.3
Thickness of sand, *in*	26	24–30	30	24	12 @ 27 3 @ 30	30	24	24	108 (f)	26
Effective size of sand, *mm*	0.43	0.42	0.40	0.46	0.4	0.40	0.38	0.37	0.40(f)	0.55
Uniformity coefficient of sand	1.45	1.4	1.65	1.48	1.75	1.6	1.50	1.6	2.0(f)	1.5
Thickness of gravel, *in*	16	16	12	18	16	19	9	18	9	20
Maximum size of gravel, *in*	2½	3	2	2½	4	2½	2	1½	¾ (f)	3
Minimum size of gravel, *in*	⅛	¼	⅜	⅜	½	⅛	½	¼	¼ (f)	⅜
Type of strainer system*	B	B	A	B	E in 12 B in 3	G	B	F	B	B
Rate of wash, *in. rise per min*	24	30	24	30	27–36	24	20–24	24–40	16	24
Agitation of sand	No	No	No	No	No	No	Air	Surf. wash	No	No
Height—top of sand to crest of trough, *in*	23	23	24	20	22	27	18	19	51	24
Clear distance between troughs, *ft*	5.12	5.83	4.42	3.73	4.50	4.25	6.0	3 50	Special circular gutters	4.63
Location of wash gullet	Center	Center	Center	Side	Center	Center	Front	Side		Center
Wash water tank capacity, *1,000 gal*	100	270	2 @ 170	124	16,000	100	60	1,000	240	84
Tank bottom above sand surface, *ft*	20	26.5	35	30	35.5	39	23	116.5	50.5	27.5
Percentage wash water—average	0.8–1.0	1.7	1.67	1.25	1.9	1.7	2.5	4	1.37–2.10	—
Filtered water reservoir:	(p)	Covered	Covered		Covered	Covered	Covered	Covered	Covered	Covered
Open or covered	Open				1.6 (b)	0.5 (b)	21	35 (b)	5.4 (b)	14.4
Capacity, *mil.gal*	3 (b)	14.5	74 (b)	5 (b)	52.5	14	56	80	72	120
Nominal capacity of plant, *mgd*	30	64	160	80						

* For explanation of letter symbols, *see* Key, p. 1849.

TABLE 1—*Concluded**

	(50)	(51)	(52)	(53)	(54)	(55)	(56)
City	Trenton, N.J.	Tulsa, Okla.	Washington, D.C. (r) Dalecarlia Plant	Wichita, Kan.	Wilmington, Del. (r)	Windsor, Ont.	Youngstown, Ohio
Population supplied (1940)	124,637 (n)	142,157 (n)	900,000	115,000 (n)	112,504 (n)	115,000	167,720 (n)
Date of beginning operation	1914	1929	1928	1940	1917 1926–39	1926	1932
Date of enlargement	—	—	—	—		—	—
Source of supply	Delaware R.	Spavinaw L.	Potomac R.	Wells	Brandywine Cr.	Detroit R.	Meander Cr.
Average analysis of raw water:		(c)			(c)		(c)
Turbidity, *ppm*	0–1000	5–1000 Avg. 15	6–3000	0	30	3–800 Avg. 35	15
Alkalinity, *ppm*	60	65–100 Avg. 80	16–120 Avg. 52	210	41	86	65
pH value—average	7.5	7.5	7.7	7.2	7.2–8.6	8.0	—
Color, *ppm*	10–100	6–200 Avg. 14	0	10	26	0	25
Mixing chamber:		(p)		(p)			
Type of chemical feed	Dry	Dry	Dry & solution	Dry	Solution	Dry	Dry
Alum added, *gpg*	0.7–1.2	0.2–3.5 Avg. 0.3	1–3 Avg. 1.3	0.07 $Al_2(SO_4)_3$ 0.23 $FeSO_4$	0.9	0.6	0 5
Lime added, *gpg*	0	0	0.6	2.0	0	0	2 Soda 5 Lime
Mixing time at nominal capacity, *min*	60	22	27	1 Rapid 30 Slow	4.2	3.8	25
Velocity at nominal capacity, *fpm*	60–80	Two 40' diam. tangential mixing chambers	60	60 Rapid 3 Slow	36	25–50	60
Length of travel, *ft*	55		1600	164	150	49.5	—
Type of baffling	Down baffles		Around end Baffles	None	Around end Baffles	Over & under Baffles & pumps	None
Type of mixing	Mech.			Mech.			Mech. agitators
Head loss in mixing, *ft*	0	0.67	0.5–2.0	0.7	0.1	0.1	0
Sedimentation basins:							
Number of basins	2 (a)	2 (a)	2 (a)	2	2 (a)	2	4
Settling time at nominal capacity, *hr*	3.0	3.0	3.0	1.0 Primary 0.5 Second.	2.4	2.0	2.0
					(d) 1917 | (d) 1926		
Velocity at nominal capacity, *fpm*	1±	0.8	3.7	1 Primary 4 Second.	1.2 | 2.3	2.3	0.8
Method of baffling	Vertical baffles	None	Around end	None	Around end | None	None	None

Turbidity of settled water, *ppm*		2–15	2–7	5–17	11	11	10	
Basins open or covered	Covered	Open	Open	Open	Covered	Open	Covered	2 Open 2 Covered
Length of one basin, *ft.*	209	151	333	110 Primary 135 Second.	157	160	124	95
Width of one basin, *ft.*	62	102	150	110 Primary 50 Second.	98	55	50	95
Depth of one basin, *ft.*	19.5	6.5–14	12–17	14 Primary 16 Second.	9	15	20	12
Total basin capacity, *mil.gal.*	3.6	3	10	2	2		1.7	3.2
Settled water conduits:								
Velocity—filter influent main, *fps.*	1.0	1.93	0.97	1.6	0.8		2.5	3.15
Velocity—filter inlets, *fps.*	1.5	1.97	1.26	1.0	2.7		2.8	1.24
Filters:								
Rate of filtration, *mgad.*	125	125	125	250	118		156	125
Number of units	16	6	20	4	10		10	10
Size of units, *mgd.*	1.875	4	4	8	2		2.5	4
Dimensions of sand bed, *ft.*	2 @ 13.5 x 24	2 @ 14 x 50	27.83 x 54	2 @ 14 x 50	2 @ 10.25 x 36		25 x 28	2 @ 12.25 x 54
Depth of filter box, *ft.*	7	9.5	15	11	10		8.5	9.25
Thickness of sand, *in.*	30	24	24	36	24		36	27
Effective size of sand, *mm.*	0.52	0.42	0.45	0.47–0.52	0.45		0.45–0.55	0.40
Uniformity coefficient of sand	1.61	1.6	1.6	—	1.6		1.5	1.60
Thickness of gravel, *in.*	12	18	18	18	18		15	12
Maximum size of gravel, *in.*	$\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$		2	$\frac{3}{4}$
Minimum size of gravel, *in.*	$\frac{1}{8}$	$\frac{5}{16}$	$\frac{1}{8}$	4 mesh	$\frac{5}{16}$		$\frac{1}{8}$	$\frac{5}{16}$
Type of strainer system*	C	B	B	B	B		B	F
Rate of wash, *in. rise per min.*	19	24	23	36	36		16–19	30–36
Agitation of sand	Air	No	No	No	No		No	No
Height—top of sand to crest of trough, *in.*	12	26	28	30	24		25	30
Clear distance between troughs, *ft.*	4.50	4.42	4.0	6.25	4.0		4.42	5.1
Location of wash gullet	Center	Center	Side	Center	Center		Front	Center
Wash water tank capacity, *1,000 gal.*	345	133	200	20	100		0	165
Tank bottom above sand surface, *ft.*	15	11.5	56	23	35.5		—	38.2
Percentage wash water—average	3.7	1.5	2.1	0.8	1.97		2–3	
Filtered water reservoir:								
Open or covered	Open	Covered	Covered	Covered	Covered		Covered	Covered
Capacity, *mil.gal.*	1.2	1 (b)	15 (b)	4	0.6 (b)		4.8	1.1 (b)
Nominal capacity of plant, *mgd.*	30	24	80	32	20		25	40

* For explanation of letter symbols, *see* Key, p. 1849.

Plant Notes

1. Akron, Ohio. The supply is impounded in a reservoir of 4.2 billion gallons (bil.gal.) capacity, on the Cuyahoga River. The capacity of the original installation of filters in 1915 totaled 20 mgd. These filters are 29 ft. long and have underdrain laterals cast in the floor under the Wheeler bottom construction. Additional filters of 10-mgd. capacity were installed in 1919 (length 25 ft.) and of 20-mgd. capacity, in 1922 (length 29 ft.). The last two installations have false-slab construction under the Wheeler bottom. A mixing chamber and second coagulation basin were then added in 1925. Filtered water storage on the distribution system totals 30.3 mil.gal.

2. Albany, N.Y. The supply is impounded on Hannacrois Creek where storage reservoir capacity is 12.1 bil.gal., and Basic Creek, where storage reservoir capacity is 716 mil.gal. This supply replaced the Hudson River supply in 1932. Filtered water storage on the distribution system totals about 200 mil.gal. in three equalizing reservoirs. Albany also has slow sand filters of about 20-mgd. total capacity, part of the old supply held in reserve for emergency.

3. Atlanta, Ga. Preliminary sedimentation in the raw water storage reservoir totals from 7 to 10 days. Filter data given are for the gravity filters: seven 3-mgd. units installed in 1923, and one additional 3-mgd. unit and six 5-mgd. units installed in 1940–41. There are also 36 horizontal type pressure filters of 0.5-mgd. capacity each and 12 Hyatt pressure filters of 0.25-mgd. capacity each, the latter being the original filters installed in 1887. The basin dimensions given are for the coagulation and settling basin built in about 1920. It has sloping sides and a hopper-shaped bottom. About one-third of the basin, at the entrance end, is used as a mud basin and may be cleaned independently.

4. Baltimore, Md. The supply is impounded on Gunpowder River. The present raw water storage is approximately 23 bil.gal. The coagulation and settling basins are somewhat irregular in shape and have sloping exterior sides. The lime is added to the filtered water to reduce corrosive action.

5. Birmingham, Ala. Lime is used only part of the time. The operation figures given are for the year 1941.

6. Buffalo, N.Y. Since there is no mixing chamber, the raw water is dosed with alum at the low lift pumps and mixed in the 78 ft. of conduit to the coagulation basins. New alum feeders and filter surface wash were being installed, 1941–42.

7. Cambridge, Mass. Preliminary sedimentation is obtained in impounding and storage reservoirs. Mixing is accomplished in the raw

water conduit to coagulation and settling basins. Entrance to coagulation and settling basins is through a wall perforated with 2-in. diameter holes. Filters are washed to a constant sand expansion, which requires variations in rates of wash between the limits given. The filtered water is aerated. A 48-mil.gal. filtered water reservoir on the distribution system is located at Payson Park.

8. Chattanooga, Tenn. Treatment usually consists only of alum addition, but at times some lime is used. Initial mixing is in the 75 ft. of raw water conduit. The first two sedimentation basins have a down baffle at each inlet and a skimming weir at each outlet. The three basins are operated in series, the third basin outlet being over six fixed skimming funnels. The old pressure filters were removed in 1935.

9. Chicago, Ill. The plant is still under construction.

10. Cincinnati, Ohio. This plant has preliminary sedimentation basins of 340 mil.gal. capacity. Modern chemical feed, mixing and flocculation facilities were installed in 1936–38. The original filter units were also completely remodeled and twelve new filters added at that time.

11. Cleveland, Ohio. At the *Division Avenue Plant* the alum is measured dry by automatic scales dumping batches of a given size at predetermined intervals into a dissolver from which it is forced by an ejector to the raw water dosing point. Mixing is accomplished by the use of a baffled chamber.

At the *Baldwin Plant* the prepared alum solution is mixed with the raw water by a hydraulic jump followed by a baffled conduit. The time at the jump is very short and the time in the rest of the mixing flume is about 1 min. The 600–700-fpm. velocity given is the velocity in the hydraulic jump. The velocity in the baffled conduit is about 300 fpm.

12. Columbus, Ohio. The raw water is impounded in a storage reservoir, of about 1.5 bil.gal. available capacity, on the Scioto River. This plant is a lime and soda-ash softening plant. Average raw water hardness is 275 ppm. and average output hardness, 100 ppm. The lime-mixing tanks are also stirred by mechanical agitators. The sedimentation basin effluent is recarbonated by a pipe grid placed in the bottom of the outlet end of the final basins. Besides the filtered water storage at the plant, two 1-mil.gal. standpipes and one 2-mil.gal. standpipe are located on the distribution system.

13. Dallas, Tex. The supply is impounded in a 63-bil.gal. storage reservoir behind Garza Dam and in three other small impounding reservoirs of 0.8 bil.gal. combined storage capacity, all on Trinity River. Filters are washed by direct pump pressure with no wash water tank. Eight new filter units were added in 1936–40. A secondary mixing basin with a 4-min.

retention period is located between the settling basins and the filters. About 80 per cent of the water used in Dallas is treated at this plant, the remaining 20 per cent being taken from deep wells is not treated.

14. Denver, Colo. In the *Marston Lake Plant* some presedimentation is obtained in impounding Marston Lake on the South Platte River. The raw water is aerated by spray nozzles, the water falling into a mixing chamber. Anthracite coal is used as the fine filtering material in place of sand. Filters are washed at 3.5 ft. loss-of-head in this low-head plant.

The *Moffat Plant* at Denver treats water diverted from the Fraser River, or the headwaters of the Colorado River, through the Continental Divide *via* the Moffat Tunnel.

15. Detroit, Mich. At the *Water Works Park Plant* chemicals are dosed ahead of raw water pumps and mixed in these pumps. This is followed by a 3-min. baffled chamber treatment at the entrance to the coagulation basins.

At the *Springwells Plant* mixing is by baffle walls and two mechanical agitators. Filtered water storage of about 10 mil.gal. is obtained in six elevated tanks on the distribution system.

16. Erie, Pa.

17. Evansville, Ind. Filtered water storage on the distribution system is of 20 mil.gal. capacity. Plant additions in 1939 consisted of four filters and new chemical feeders.

18. Flint, Mich. The plant was adapted to softening in 1939 by the addition of one primary mixing tank, three coagulation basins and one mechanically cleaned sedimentation basin, together with new chemical feed equipment.

19. Fort Wayne, Ind. The raw water supply is impounded in a storage reservoir of about 700 mil.gal. capacity on the St. Joseph River. The plant softens the water with lime and soda ash as well as clarifying it. Maximum raw water hardness is 475 ppm., 300 ppm. being the average. Average output hardness is 100 ppm. Settling basins are of the two-story type.

20. Fort Worth, Tex. Presedimentation takes place in the 15-bil.gal. impounding reservoir, Lake Worth, on the West Fork of the Trinity River. The inlet to the sedimentation basins is behind a curtain wall or down baffle and the outlet is over a skimming weir. Additional mixing facilities were provided in 1932.

21. Grand Rapids, Mich. This plant now clarifies Lake Michigan water. A grit basin precedes the mixing chamber. The five filters added in 1930 are 20.5 ft. by 42 ft. in size and filter at a lower rate (about 100 mgd. per acre). Storage on the distribution system totals about 15 mil.gal.

22. Hamilton, Ont.

23. Indianapolis, Ind. The supply for the *White River Plant* is impounded at Broad Ripple on the White River, with very small storage behind the diversion dam. The coagulation basins have sloping sides with paved slopes. Indianapolis also has slow sand filters of 36 mgd. capacity on the White River supply, and some well water is used. The effluents from both rapid sand and slow sand filters are combined in a 1-hr. detention basin before pumping to distribution.

The *Fall Creek Plant* is supplied from an 8-bil.gal. impounding reservoir on Fall Creek.

24. Kansas City, Kan. This plant also has two primary basins for preliminary sedimentation before the raw water is dosed with chemicals. The coagulation basins are operated in series and are allowed to fill up with sediment to within 3 ft. of water surface before cleaning, at which depth the time of retention is about 6 hr. Filtered water storage on the distribution system amounts to 13 mil.gal.

25. Kansas City, Mo. The raw water receives preliminary sedimentation in four 200-ft. diameter circular tanks with mechanical clarifiers before being dosed with chemicals. Initial mixing is in hydraulic jump channels recently built across the two 90-ft. diameter original mixing chambers. The plant was adapted to softening in 1941 by the installation of rapid mix channels and flocculating and sludge removal equipment in existing basins. A new chemical building and chemical handling and feeding equipment were also added. Reservoirs on the distribution system hold 62 mil.gal. in storage.

26. Knoxville, Tenn. Two circular mixing chambers with mechanical stirrers are operated with tangential flow at velocities up to 2 fps. Water enters tangentially at the tops and exits in the center of the bottoms. The basin flow is straight through from the west to the east end. Widths of basin passes vary and basins have sloping sides, the length and width dimensions given being those of the average water surface. Basin inlets are located behind a fence of wooden slats and basin outlets are skimming weirs. The storage on distribution system is 10 mil.gal. for equalizing and 1 mil.gal. for reserve.

27. Louisville, Ky. Preliminary sedimentation in two storage reservoirs of 55 mil.gal. capacity, each, or about one day's retention time, precedes dosing of raw water. There is no regularly designed mixing chamber. Raw water is dosed in a slotted controller and is discharged through a sluice gate into each basin. The coagulation basins were revamped in 1929. The six original filters, built in 1909, were reconstructed in 1931. A new 30-mil.gal. filtered water storage reservoir is located about twelve miles from the filter plant, acting as an equalizing reservoir on the distribution system. Surface wash was installed in the filters in 1940.

28. Miami, Fla. In this softening plant, mixing tanks are 30 ft. in diameter and 22 ft. deep. The water travels circumferentially and downward in a 15-min. period, with stirring by revolving paddles. The clarifier basin has mechanical equipment for stirring and frequent sludge removal. Settled water is recarbonated before filtering, the recarbonation basin having a ½-hr. retention period. About 5 mil.gal. filtered water storage is obtained in the several elevated tanks on the distribution system. The filter plant capacity was doubled (from 8 to 16 mgd.) in 1936 by the addition of eight filters, one mixing tank, one flocculator tank and one clarifier tank.

29. Milwaukee, Wis. Settling is accomplished in two-story basins. The wash water tank is located on a bluff across the highway from the plant.

30. Minneapolis, Minn. At the *Columbia Heights Plant* one of the two old 47-mil.gal. raw water storage reservoirs was used as a presedimentation basin and the other was covered and used as a filtered water reservoir, flow from which is by gravity to the part of city served.

The supply to the filters will be softened in a *new preliminary treatment plant*, which was under construction when data were furnished in 1941.

31. Montreal, Que. The population served includes that of Montreal and adjoining municipalities. The old slow sand filters were abandoned in 1935. Air, at a rate of 4 cu.ft. per sq.ft. per min., is used for agitating the sand in washing the filters. Three reservoirs float on the distribution system: one of 37 mil.gal. (Imperial) capacity; one of 60 mil.gal. (Imp.); and one of 2 mil.gal. (Imp.).

32. Nashville, Tenn. The raw water is given ½-hr. presedimentation in a grit chamber before dosing. Filtered water storage on the distribution system totals 50 mil.gal.

33. New Orleans, La. Grit basins are provided for preliminary sedimentation. Filter underdrains are of seamless brass tubing, with the orifices pressed in to catch some impact of the velocity.

34. Norfolk, Va. Each plant has the benefit of presedimentation in raw water impounding reservoirs. The Lake Prince Reservoir has about 4 bil.gal. storage capacity. New plant additions were under construction at the time of this survey (1942).

The coagulation basins at the *Moore's Bridges Plant* are of irregular width and have sloping sides. The dimensions given are of average water surface.

At the *Lake Prince Plant* the water is aerated by a water fall immediately after mixing in a closed mixing chamber and is discharged from the aerator into the coagulation basins.

35. Oakland, Calif. This city's supply is impounded on the Mokelumne River. The plants supply the nine cities which compose the East Bay Municipal Utility District—Richmond, El Cerrito, Albany, Berkeley, Emeryville, Oakland, Alameda, Piedmont and San Leandro. The dis-

tribution system is inter-connected between the *San Pablo Plant*, located at North Berkeley, and the *San Leandro Plant*, located at East Oakland. The filter underdrains at the *Upper San Leandro Plant* are of brass tubing. These filters are washed one-half section at a time.

36. Oklahoma City, Okla. The supply is impounded in a 5.5-bil.gal. storage reservoir on the North Canadian River. The plant consists of primary aerator, primary mixing chamber, coagulation basins, recarbonation at basin outlet, secondary mixing chamber, filters, 1-mil.gal. clear well, secondary aerator and 2-mil.gal. clear well. The plant softens as well as clarifies the raw water. The secondary mixing chamber has a 20-min. retention and uses a rapid mix by three motor-driven agitators. An elevated tank of 0.5 mil.gal. capacity floats on the distribution system.

37. Omaha, Neb. The plant has six large coagulation and settling basins of varying sizes, with a total capacity of 80 mil.gal. Parts of these basins are used for dosing and mixing. The filters may draw water from any of these basins.

38. Ottawa, Ont.

39. Passaic Valley Water Co. Little Falls Plant. This plant supplies Paterson, Bayonne, Passaic, Clifton and several other New Jersey towns and municipalities. The plant has no regular mixing chamber, raw water being dosed as it enters the coagulation basins. The 1902 filters have wash gutters around the walls as well as across the center of the filter layer. The 1919 filters have central gutters with a front gullet. The new Wanaque water supply includes 27 pressure filters of 0.75 mgd. capacity, without coagulation or pretreatment. The distribution system includes three reservoirs, one each of 150, 30 and 3 mil.gal. capacity.

40. Philadelphia, Pa. Each plant also has slow sand filters in operation; a third slow sand plant, of 24 mgd. capacity, is located on the Schuylkill River; and Torresdale slow sand filters of 200 mgd. capacity are located on the Delaware River. The three storage reservoirs on the distribution system have capacities of 600, 70 and 40 mgd.

The coagulation basins at the *Belmont Rapid Sand Plant* are irregular in shape. Plan dimensions given are of average water surface.

41. Providence, R.I. Some presedimentation is obtained in a 37-bil.gal. impounding reservoir. The raw water is aerated as it enters the plant. Ferric chloride is applied and mixed in a raw water conduit 825 ft. long at a velocity of 15 fpm. Hydrated lime is added at a point 270 ft. before entrance to the 35-ft. diameter mixing tank, which has rotary flow with a tangential bottom inlet and a tangential top outlet. The irregularly shaped sedimentation basins were reshaped, deepened and lined with concrete and four new filters were added in 1939–40. The filtered water is aerated by the available unused filtering head on spray nozzles. There is no clear water storage at the filter plant. The filtered water storage is

on the distribution system in the 39-mil.gal. Neutaconkanut low service reservoir and the 12-mil.gal. Longview high service reservoir, both covered. This rapid sand plant replaced the original slow sand filters at Providence.

42. Reading, Pa. This plant supplanted two of Reading's four small slow sand filter plants. The settling basins have perforated brick walls across inlet and outlet ends. They may be operated in parallel or in series.

43. Richmond, Va. The raw water is polluted by sulfite waste from paper pulp mills upstream. The plant has two presedimentation basins, of about 85 mil.gal. capacity each, which, used singly, give about four days settling period. Additional mixing of 70 min. is provided by mixing paddles installed in entrance end of sedimentation basins. Sedimentation basins are of somewhat irregular shape, but about the same in volume. The dimensions given are averages. Filter inlets are at the rear of the filters. Filtered water storage by gravity is 3 mil.gal., but, by pumping, an available storage space of 7.5 mil.gal. may be used. Filtered water is aerated by pumping through spray nozzles during the nine warm months of the year. Occasionally, chlorinated copperas (2.5 gpg.) is used instead of alum. Pre-chlorination (1.2 to 7.5 ppm.), with de-chlorination by sulfur dioxide to a residual of 0.2 ppm. applied to filters, is practiced. Finished water is corrected by lime to a pH of 8.7 and sterilized with chlorine and ammonia.

44. Sacramento, Calif. To the original plant of 32 mgd. capacity, eight filters were added in 1927 and additional preliminary treatment was added in 1932, the last addition being made in 1937. The new preliminary treatment works consist of a grit chamber 50 × 50 × 4 ft. deep; a new aeration field of nozzles; four mixing tanks, 56 ft. in diameter by 23 ft. deep, with pump impeller type mechanical mixers; two sedimentation basins, 100 ft. square by 10 ft. deep, with sludge collecting equipment; and 4-in. "surfasettlers," 44 × 145½ × 9 ft. deep, with intermediate sloping shelves and sludge collecting equipment.

45. St. Louis, Mo. In the *Chain-of-Rocks Plant*, raw water passes through a grit chamber for presedimentation before dosing. Lime is added at the entrance to the mixing basin and iron sulfate at the exit to the mixing basin. The sulfate mixes in the conduit to the settling basins. Six settling basins are used in series. The water from these is dosed with alum at the Venturi meters before entering a secondary coagulation chamber, where some mixing and coagulation is obtained in a pair of basins, operated in parallel. It is then applied to the filters, and, after chlorination, flows to Baden and Bissell's Point for storage in 20- and 54-mil.gal. reservoirs, respectively. Compton Hill Reservoir provides 85-mil.gal. storage on the distribution system in the area served by this plant.

In the *Howard Bend Plant*, raw water is pumped to two 150-ft. square presedimentation basins, equipped with clarifiers, for 2-hr. sedimentation

before dosing. Lime is added in a rapid mixing basin of the around-the-end type before entering the four tangential mixing chambers operated in parallel. Iron sulfate is dosed at the entrance to the tangential mixing chambers. The mixed water enters two 150-ft. square coagulation basins, equipped with clarifiers. These basins operate in parallel and have a retention period of 2 hr. From these basins, the water flows to two final sedimentation basins operated in parallel for 8.7 hr. of final settling. After final settling it passes to a recarbonating basin where, after recarbonation, alum is dosed for secondary coagulation before the water is applied to the filters. A 5-mil.gal. clear well between the filters and the high-pressure pumps provides for flexibility in pumping to the 100-mil.gal. Stacy Park reservoir on the distribution system for the area supplied by this plant.

46. St. Paul, Minn. About 95 per cent of supply is obtained from the Mississippi River. This is pumped into a chain of fourteen small natural lakes partly supplied by springs which also add to the supply. Presedimentation is obtained in these lakes. Mixing is assisted by compressed air diffused into the water as it enters the mixing chamber. This accomplishes some aeration as well as thorough initial mixing of chemicals. The plant was adapted to softening in 1939 with the addition of a flocculating basin and a mechanically cleaned clarification basin. The sedimentation basins are normally used in series and the velocity figure is for series operation. These basins are now used for secondary settling. Six new filters were built in 1939, three of which were equipped and put in service. Two filtered water reservoirs, one of 16 mil.gal. and one of 18 mil.gal. capacity, float on the distribution system.

47. Tampa, Fla. The impounding dam washed out in 1933, so that water now is simply diverted. The original propellor mixing equipment was removed in 1935.

48. Toledo, Ohio. The old supply from the Maumee River was replaced by a new supply from Lake Erie, including a new filter plant in 1942.

49. Toronto, Ont. The *Island Filtration Plant* has no regular mixing chambers or coagulation basins, but raw water is dosed at pump and is mixed in the pipes conveying it to filters. The filters are of the "drifting sand" type. The two main wash water gutters for each filter are in concentric circles connected radially by six lateral gutters equally spaced. Sand is continually and slowly removed, washed and returned. The outputs of the drifting sand filters and slow sand filters are mixed and pumped into the same mains. The *Victoria Park Plant* was completed in 1941. Toronto has two storage reservoirs, one of 40 and one of 60 mil.gal. capacity, on the distribution system.

50. Trenton, N.J. Sudden changes in the character of the raw water are frequent; e.g., turbidity may change from 0 to 1,000 ppm. in less than an hour. Flocculating equipment was added in one settling basin in 1940.

51. Tulsa, Okla. Some presedimentation is obtained in the 20-bil.gal. impounding reservoir, Spavinaw Lake, and some in the 500-mil.gal. Mohawk Lake at the plant. The raw water is aerated by injecting compressed air through "Filtros" plates in the bottom of the raw water conduit. The filter underdrains are of seamless brass tubing with orifices pressed in to catch some impact of velocity. A 10-mil.gal. filtered water storage reservoir floats on the distribution system.

52. Washington, D.C. Some presedimentation is obtained in the 100-mil.-gal. Dalecarlia raw water storage reservoir. Alum is dosed in solution and lime by dry feed. The lime is used to raise the pH of the filtered water to prevent corrosion. The two mixing chambers may be operated in series or parallel, parallel operation data being charted. The longitudinal around-the-end type baffles in the coagulation basins are slightly oblique to cause a slight reduction in velocity as the water flows through the basins. These basins are operated normally in parallel. Their bottoms are sloped to facilitate cleaning. Wooden slat bottoms in the filters were replaced with perforated pipe underdrains in 1941–42. When it is filled, the main filtered water reservoir throttles the filters. There are also four other filtered water reservoirs in the distribution system. A slow sand plant supplies the low service areas of the city by gravity.

53. Wichita, Kan. This plant softens a new well supply developed in 1940. The average raw water hardness is 160 ppm. and the finished water hardness, 120–130 ppm.

54. Wilmington, Del. The impounded supply serves through two filter plants, one slow sand and one rapid sand type. Part of raw water supply passes through a 35-mil.gal. presedimentation reservoir and a 12-mil.gal. slow sand plant, to a 6-mil.gal. filtered water reservoir. The other part passes through the rapid sand plant. Four 2-mgd. filter units were added to the rapid sand plant in 1939. The system includes a 40-mil.gal. filtered water reservoir on the low service distribution system and a 7.5-mil.gal. emergency reservoir on the high service distribution system.

55. Windsor, Ont. Two filter units on opposite sides of the operating gallery are operated from the same table. The filter gravel is bonded together with portland cement grout. The two mixing chambers are baffled to give decreasing velocities. The length of travel and velocity of mixing given are those of the mixing chambers proper. The time of mixing includes pumps and conduits preceding these chambers. An additional 2.5-mil.gal. filtered water reservoir was added in 1941.

56. Youngstown, Ohio. This plant softens and clarifies the new Meander Creek supply. The old plant on Mahoning River supply was abandoned in 1932–35. In addition to the 1.1 mil.gal. clear well at the plant, the system includes standpipes of 3 mil.gal. capacity on the distribution system and a distributing reservoir of 30 mil.gal. capacity.

TABLE 2

U.S. and Canadian Cities of Over 100,000 Population Which Have Rapid Sand Filtration Plants, January 1942

Akron, Ohio
Albany, N.Y.
Atlanta, Ga.

Baltimore, Md.
Birmingham, Ala.
Buffalo, N.Y.

Cambridge, Mass.
Charlotte, N.C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio

Dallas, Tex.
Denver, Colo.
Detroit, Mich.

Erie, Pa.
Evansville, Ind.

Flint, Mich.
Fort Wayne, Ind.
Fort Worth, Tex.

Grand Rapids, Mich.

Hamilton, Ont.

Indianapolis, Ind.

Kansas City, Kan.
Kansas City, Mo.
Knoxville, Tenn.

Louisville, Ky.

Miami, Fla.
Milwaukee, Wis.
Minneapolis, Minn.
Montreal, Que.

Nashville, Tenn.
New Orleans, La.
Norfolk, Va.

Oakland, Calif.
Oklahoma City, Okla.
Omaha, Neb.
Ottawa, Ont.

Paterson, N.J.
Philadelphia, Pa.
Providence, R.I.

Reading, Pa.
Richmond, Va.

Sacramento, Calif.
St. Louis, Mo.
St. Paul, Minn.
San Diego, Calif.

Tampa, Fla.
Toledo, Ohio
Toronto, Ont.
Trenton, N.J.
Tulsa, Okla.

Washington, D.C.
Wilmington, Del.
Windsor, Ont.
Wichita, Kan.

Youngstown, Ohio

TABLE 3

U. S. and Canadian Cities of Over 100,000 Population Which Do Not Have Rapid Sand Filtration Plants, January 1942

City	*Remarks*
Boston, Mass.	Impounded mountain water supply
Bridgeport, Conn.	Surface supply
Camden, N.J.	Artesian wells
Canton, Ohio	Underground supply
Dayton, Ohio	Well supply
Des Moines, Iowa	Infiltration gallery
Duluth, Minn.	Surface supply—Lake Superior
Elizabeth, N.J.	Water furnished by Newark, N.J., Elizabethtown Water Co. Cons. and Plainfield Union Water Co.
El Paso, Tex.	Deep well supply
Fall River, Mass.	Surface supply
Gary, Ind.	Lake Michigan

TABLE 3—*Continued*

City	*Remarks*
Hartford, Conn.	Slow sand filters
Houston, Tex.	Deep well supply
Jacksonville, Fla.	Artesian wells
Jersey City, N.J.	Surface supply
Long Beach, Calif.	Artesian wells
Los Angeles, Calif.	Impounded mountain water supply
Lowell, Mass.	Slow sand filters for iron removal
Lynn, Mass.	Surface supply
Memphis, Tenn.	Iron removal filters only
Newark, N.J.	Impounded gravity supply
New Bedford, Mass.	Impounded supply from protected watershed
New Haven, Conn.	Slow sand filters
New York, N.Y.	Impounded mountain water supply
Peoria, Ill.	Underground supply
Pittsburgh, Pa.	Slow sand filters
Portland, Ore.	Surface supply
Quebec, Que.	
Rochester, N.Y.	Lakes
Salt Lake City, Utah	Impounded mountain water supply
San Antonio, Tex.	Deep well supply
San Francisco, Calif.	Impounded mountain water supply
Scranton, Pa.	Impounded supply—Small 6-mgd. pressure filter plant on reserve supply
Seattle, Wash.	Impounded mountain water supply
Somerville, Mass.	Supplied from Boston Metropolitan Water System
South Bend, Ind.	Artesian wells
Spokane, Wash.	Underground supply
Springfield, Mass.	Impounded mountain water supply
Syracuse, N.Y.	Impounded gravity supply
Tacoma, Wash.	Mountain water supply
Utica, N.Y.	Impounded surface supply
Waterbury, Conn.	Impounded surface supply
Winnipeg, Man.	Lake
Worcester, Mass.	Impounded supply
Yonkers, N.Y.	Slow sand filters

TABLE 4

U.S. and Canadian Cities of Over 100,000 Population Which Have Slow Sand Filter Plants, January 1942

CITY	PLANT SIZE	CAPACITY	DATE BUILT
	acres	*mgd.*	
Albany, N.Y.*	5.6	20	1899
Denver, Colo.	10	30	1903
Hartford, Conn.	5.5	25	1921–22
Indianapolis, Ind.—White River Supply	4.8	36	1903
Lowell, Mass.†	—	8	1914
New Haven, Conn.	—	12	1906
Philadelphia, Pa.:			
Lower Roxborough	2.7	12	1898
Upper Roxborough	5.6	24	1900
Belmont	13.2	50	1904
Queen Lane	15	60	1912–15
Torresdale	48.8	200	1905–07
Pittsburgh, Pa.	56	200	1908
Reading, Pa.:			
Antietam	—	5.5	1905
Bernhart	—	4.5	1911
Springfield, Mass.	6.2	20	1909 & 1924
Toronto, Ont.—Island Filtration Plant	9.6	58	1911
Washington, D.C.‡	29	75	1905
Wilmington, Del.	2	12	1907–10
Yonkers, N.Y.	4	20	1902, 1908 & 1914

* Not operating, but held in reserve.

† For iron removal.

‡ On low service area.

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An Operator's Monthly Balance Sheet

By Charles E. Moore

IT HAS been said that necessity is the mother of invention. At this time the enormous need of governmental revenue is a nightmare to tax-levying bodies—federal, state and local—but even prior to the present war effort and arising out of the World War, although perhaps somewhat indirectly, new sources of governmental revenue were hard to find.

The scarcity of new things to tax or the alleged existing high rate of taxable things has led to considerable demand for utility service to be entirely self-supporting in all of its activities.

"Necessity" has undoubtedly played a large part in the development of present day bookkeeping and the issuance of a "Balance Sheet" at the end of each fiscal year. The development of bookkeeping and accounting, including the balance sheet, shows the same general lines of development as present-day so-called "big business."

In the early days the entire set of books and records would now, undoubtedly, be classified as a mere cash account, showing little more than receipts and disbursements. "Necessity," as the size of a particular business or industry grew, carrying with it the need of broad-gaged financing on the one hand and the submission of reports for the purposes of taxes on the other, played no small part in the development of financial records.

From the operator's standpoint such records were, and in many cases still are, largely of secondary consideration to him and still serve only for the purpose of enabling him to secure proper and necessary financial assistance on the one hand, and of keeping his expenses, under the heading of "Taxes," down to the proper and true amount on the other. It is not astonishing, therefore, that those charged with the development of what began as a vocation and has now become a profession, should have developed the accounting system along lines primarily for the purpose of answering these immediate needs. It is equally natural that the operator and average business man today has little or no real understanding of the

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A paper presented on June 25, 1942, at the Chicago Conference by Charles E. Moore, Mgr., Water Dept., Roanoke, Va.

figures appearing on the usual form of balance sheet, when he tries to apply them to current operating conditions.

With the changed viewpoint as to governmentally operated utilities generally, it is becoming more and more important to the operator to keep and maintain a financial record of the operations in such shape and fashion that he may not only understand all the figures but that they shall be in such form that he can demonstrate to his public, which after all is the owner of the plant, exactly where the money which has been received and which his public has paid in, in the form of bills for service rendered, has been used, be it a water, gas or electric plant.

The inquiring citizen and taxpayer of the community is eternally present. Any explanation as to conditions ten months ago is far from satisfactory. He always wants to know what the situation is now.

While an annual financial statement and perhaps, on occasion, a tentative statement for the last six months may have sufficed for the banker, and while the last annual statement may have entirely sufficed for tax purposes, the inquiring consumer and taxpayer desires more recent figures. The answer to this is the issuance of a monthly balance sheet, which will go a long way toward providing the operator with a record from which he can definitely and in detail point out to the citizen exactly what is happening to the money he pays in to the municipally owned utility for the service rendered, both for capital additions and for operation and maintenance charges.

While it is possible to demonstrate and speak intelligently from the usual form of balance sheet, the majority of people not accustomed to financial statements cannot readily absorb the true meaning and any explanation fails to carry conviction.

It is believed by the writer, and it is the purpose of this paper to demonstrate, that it is an exceptionally simple matter to rearrange the present usual form of balance sheet without in any way destroying information heretofore necessary for financial experts. In other words, it is possible to have it in such shape that the average person who would make inquiry can, with a minimum amount of explanation, obtain a reasonably clear and comprehensive picture of what he has received for the payments he has made and what profit, if any, has inured to him during the period that he and his fellow citizens have owned the utility.

Generally speaking, the value of the property owned, the amount of bonds outstanding and the real equity the taxpayer has are the things that make the biggest impression upon him. He can understand very readily that if the entire real property is worth a fixed amount of money and that the bonds outstanding are equal to 75 per cent of that property, someone must pay the interest on those bonds. If the bonds are being paid off

EXHIBIT A

ITEM	TOTAL	CHANGE THIS MONTH	CHANGE THIS YEAR	ITEM	TOTAL	CHANGE THIS MONTH	CHANGE THIS YEAR
Fixed Capital Assets							
Fixed Assets—original	(1)	(a)	Σ(a)				
" " —Earnings	(2)	(b)	Σ(b)				
" " —Reserves	(3)	(c)	Σ(c)				
" " —Bonds	(4)	(d)	Σ(d)				
" " —Intangible	(5)	(e)	Σ(e)				
Cash From Bonds	(6)	(f)	Σ(f)	Bonds Payable	(10)	(j)	Σ(j)
Cash From Reserves	(7)	(g)	Σ(g)	Contributions Non-Refundable	(11)	(k)	Σ(k)
Unamortized Costs	(8)	(h)	Σ(h)	Contributions W.P.A.	(12)	(l)	Σ(l)
Notes Receivable	(9)	(i)	Σ(i)	Surplus Invested in Fixed Capital	(13)	(m)	Σ(m)
Totals	"A"	"B"	"C"		"A"	"B"	"C"
Current Reserves							
Debt Retirement—Cash	(14)	(n)	Σ(n)				
" " —Securities	(15)	(o)	Σ(o)				
Total	"D"	"E"	"F"	Reserves for Debt Retirement	"D"	"E"	"F"
Replacement—Cash	(16)	(p)	Σ(p)				
" —Securities	(17)	(q)	Σ(q)				
" —Cash Reinvested	(18)	(r)	Σ(r)				
	"G"	"H"	"I"	Reserves for Replacement	"G"	"H"	"I"
				Interest Coupons Payable	(19)	(s)	Σ(s)
				Accrued Interest	(20)	(t)	Σ(t)
Cash for Bond Interest	"J"	"K"	"L"		"J"	"K"	"L"
				Consumers Deposits	(21)	(u)	Σ(u)
				Contributions Refundable	(22)	(v)	Σ(v)
Cash Consumers Deposits	"M"	"N"	"O"		"M"	"N"	"O"
Current Assets							
Accounts Receivable	(23)	(w)	Σ(w)				
Unbilled Revenue	(24)	(x)	Σ(x)				
Prepaid Items	(25)	(y)	Σ(y)				
Materials and Supplies	(26)	(z)	Σ(z)				
Item Total	"P"						
Cash	(27)	(aa)	Σ(aa)				
Reserves for Bad Debts	(red) (28)	(bb)	Σ(bb)				
Accounts Payable	(red) (29)	(cc)	Σ(cc)	Surplus Invested Materials & Supplies	(30)	(dd)	Σ(dd)
Item Total	"Q"			Operating Surplus	(31)	(ee)	Σ(ee)
Net Total	"R"	"S"	"T"	Total Surplus	"R"	"S"	"T"

serially, he can also readily comprehend what it takes to meet those payments.

Likewise, any such person can appreciate the necessity of regularly accumulating funds to meet interest payment when due and funds to pay off the debt when it becomes due.

The current assets, such as accounts receivable and money in the bank, and the current bills to be paid are analogous to his own daily life. They represent his paycheck and his monthly bills. It, therefore, seems a common-sense thing to arrange the operating monthly balance sheet in these three groups. With each group balanced off, he can, in regular order, comprehend exactly the condition of the utility in which he has such a substantial interest not only as user of the service but also as part owner.

In the accompanying form of operator's monthly balance sheet (Exhibit A) such an arrangement has been made and in it are all of the elements contained in the usual present-day balance sheet, but those items are regrouped and combined, more clearly and quickly to demonstrate the true condition, and are presented in a form which the experience of the writer has already proved is quite readily understood by the average citizen.

No figures have been used in this operating monthly balance sheet example, but for purposes of identification and discussion, the items have been numbered and lettered. Also for the purposes of discussion, the following assumptions are made: that the period of elapsed time since the plant was acquired is ten years; that bonds in the entire amount of the original acquisition costs were issued; that the terms of these bonds were such that a fixed amount of the original principal must be set aside each year until the entire amount is paid; that the sole source of revenue for all purposes is from the sale of service.

The ensuing discussion is based upon these premises, and the examination and analysis of the resultant balance sheet is being made as of today, ten years after the plant was built and paid for out of funds derived from the sale of bonds ten years ago and during which time only a part of the bonds have actually been paid off.

Fixed Capital Assets

Ten years ago the city bought the water works. It sold —— thousand dollars worth of bonds. Since then it has paid off, each year, a part of these bonds, so there is still outstanding, in the hands of the public, item 10.

While the city has owned the plant, there have been additions to mains and services that are unprofitable, being for the benefit of a few. Such additions were paid for outright by the few. The total of such additions is item 11. Certain other additions were made that benefited every

consumer. Of the cost of these, the city paid part and W.P.A. paid part. The value of W.P.A.'s part is item 12.

Some of the original bonds have been paid off. New mains, services, pumps, etc., have been added. Some of the original property purchased has rusted out and has been replaced.

Item 13 equals the sum of the bonds paid off, the new property added and the costs of all replacements that were in excess of the original purchase price, all of which have been paid for out of revenues from the sale of water and service. The total, "A," of these items is the total of "Fixed Capital Liabilities."

To find the total of "Fixed Capital Assets," first to be considered is item 1, which is the original cost of that part of the original plant now still being used and which was paid for by the sale of bonds. Those additions made since purchase and which have been paid for out of earnings are represented by item 2. That part of the plant that has been renewed or replaced since purchase is represented by item 3. The money to make these replacements also came from earnings.

More bonds were sold at the time of purchase than were necessary to meet the purchase price. Some of this money was spent after purchase in new and added plant; this is represented by item 4.

Interspersed in items 2 and 4 are the values of 11 and 12, depending on which segregated cash was appropriated for general improvements.

Item 1 represents real property that can be inventoried. There were certain intangible items; such as "Going Concern Value," "Franchise Value," etc., that were purchased and paid for by the sale of bonds; these are represented by item 5.

The cash remaining from the sale of bonds, available for new additions only, is represented by item 6.

Certain items of property originally paid for by the sale of bonds have rusted out or have otherwise been disposed of, but, due to change of times, it was not necessary to replace them at once. Cash (out of reserve for replacement funds) has been set aside equal to their original cost. This money is available only for replacements or new additions, as shown in item 7.

Certain costs, such as engineering, bond discount and legal and other costs during the process of acquiring this property were paid for out of the proceeds from the sale of bonds. These items form no part of the inventory either real or intangible. As soon as earnings permit, they should, on authorization of the governing body, be written off; but until then they are a part of "Fixed Capital," being represented by item 8.

After the property was originally acquired, certain real property was deemed of no value for production or distribution of water. This property

was therefore sold and a note taken in payment. Until paid, this note also forms a part of the "Fixed Capital," being represented by item 9.

The total of items 1 to 9 inclusive is "A," as is the total for items 10, 11, 12 and 13.

Current Reserves

Each month there is set aside from earnings cash to be accumulated so that when those bonds outstanding in the hands of the public become due there will be funds on hand to make the payments. These accumulated monthly figures are represented by item "D." Bonds are due only once each year, small amounts the first few years then larger amounts in later years. The deductions each month are a monthly average for all the years. Accordingly, only enough cash is retained to meet the year's payments, the balance being invested in U.S. Government Bonds temporarily. These two items are represented by items 14 and 15 and their total is "D."

Each month there is also set aside from earnings, cash to be expended later for replacement of any item in the system, item "G." Opinion varies on how large this amount should be. Generally speaking, there are two general views—that the amount should be: (1) enough to replace all items at original cost; (2) enough to replace all items at replacement cost. Accepting, for illustration, the former view, the correctness of the monthly deduction can only be made by inspection and review after several years of uniform practice in the expenditures made under this heading. There are, however, two important features to be maintained.

Accruing depreciation of property for periods will be far greater than maturing depreciation; then, in some years, depreciation will mature in large amounts of money. Cash retained for current maturing depreciation is represented by item 16; surplus cash for a large unit sometime in the near future which can be reinvested in U.S. Government securities is represented by item 17.

The excess of replacement cost over original cost is represented by item 18, the corresponding credit, of course, being a part of item 13 as above stated. At the end of ten years or so this figure begins to have a real value. It will then be an important element in the determination of the correctness of the monthly deductions accumulated in item "G."

Items 3 and 7 combined will represent the total expenditures made from item "G," and this total plus items 16 and 17 of the same date equals total deductions made from earnings over the total history. This figure will impress the consumer, i.e., the "citizen and taxpayer of the city." The total of items 16, 17 and 18 equals total "G."

Each month there is deducted from earnings cash which is set aside to meet the interest payments on bonds outstanding in the hands of the

public. This is represented by items "J." As interest is paid each three months or six months, none of this cash is invested.

Some people are careless in not presenting their coupons for payment promptly. The sum of such coupon payments as are past due is represented by item 19 and the amount of interest accrued but not yet due is represented by item 20; the sum of the two is item "J."

To guard against loss from bad debts, customers are required to make deposits. These deposits are represented by item 21.

Certain additions to property, such as mains, services, etc., have only speculative value. Such new additions are paid for by the benefited consumers. If the sale of service and water from such additions to plant become profitable or self-supporting, the customers who have financed them are given a refund in whole or in part. The total of such money as may be refunded, if and when, is represented by item 22. The sum of items 21 and 22, "M," is held in cash against the day that the deposit for guarantee of water bills is properly refunded and the repayment made to those originally paying the cost of subsequent profitable plant additions.

Current Assets

Heretofore balance sheet figures have listed "Cash" as the first item. No doubt this is because, in making an audit of a department or business, the first thing the auditor does is to "count the cash." Mere cash on hand at a specific date has no real value, either for operating purposes or for forecasting conditions, until all other liabilities are taken into consideration. For instance, of what particular benefit to the operator is $100,000 cash in bank, when accounts payable may be $90,000? All he really has free is $10,000.

Accordingly, accounts receivable, unbilled revenue, prepaid items and materials and supplies on hand, items 23, 24, 25 and 26, should be totaled. These items are more or less "frozen." Their sum, "P," is useful in later calculations.

The use of the modern system of continuous billing, i.e., the billing of part of the customers each working day, each bill carrying a fixed number of grace days, has been assumed in this discussion. Under such a system, the gross dollars of accounts receivable will always remain within narrow limits, and the dollar value is, therefore, in a sense a frozen item as distinguished from the issuance of all bills simultaneously at a quarter period, resulting in a high figure one month and a materially reduced figure the next month.

Next, for convenience, are listed cash, item 27, reserves for bad debts (deposits will not compensate for all loss), item 28 (red), then accounts payable, item 29 (red). This order permits easy determination of the net

of these three items, item "Q." This total represents the real free and unencumbered cash. The total of this group, "R," is equal to the total surplus.

There are many ideas and few real facts about the real salvage value of materials that can be reclaimed in the process of abandonment and replacement of plant as compared with the original cost. This controversial figure is properly a part of the correct determination of the proper deduction from earnings for replacement reserve.

To simplify accounting, to arrive at the true value and at the same time to obtain the maximum value of salvage and have a true picture from the physical standpoint, an account, entitled "Surplus Invested in Materials and Supplies," is maintained, item 30. Operating surplus, item 31, is therefore the figure which, taken together with item 30, equals total surplus, "R."

All materials salvaged at time of removal have in fact an unknown value. Often, construction conditions do not permit final restoration of this salvaged material to good condition then and there. If this is true, the material should be thrown on the scrap pile. Final accounting of all the new construction work being done in the field can then go ahead.

Days, weeks and even months later, as other demands may permit, the scrap pile should be given attention. All expenses should be charged to the stock account. When all work is done, the market value of salvaged materials should be determined and the expense of salvage subtracted. The difference, which is true salvage value, should be charged to stock and credited to "Surplus Invested in Materials and Supplies." After a reasonable period this accumulated surplus matched against item 3 will give a true picture of the value of salvage, and this value will have been obtained with a minimum of effort and expense.

Use of the Balance Sheet

Any plant manager who uses such a monthly balance sheet over long periods knows where he has been, where he is now, and has a reasonably fair chance of determining his future direction.

The customer who is up in arms because his "water bill is too —— much," can quickly grasp enough understanding of such a balance sheet, as will pin his ears back, or make him proud of his municipal water works. Of course, the manager must be reasonably good himself, for "figures don't lie, even if liars will figure."

Further refinements and valuable information are further obtained by carrying on this same balance sheet two additional columns—the changes (red or black figures), for the current month in one, and for the accounting year to date in the other.

Although the foregoing discussion has been based on the outright purchase of the plant ten years ago and accurate and complete accounting since, any plant can at any time open up and continue such a record. Such a record should begin with a complete detailed inventory of plant, pricing it. There are bound to be certain known items, so that ultimately a fairly accurate start can be made, by adjusting estimated figures to known facts.

When the original entries are a few years old it will be of minor importance whether a certain item originally cost the inventory price or just a little more or less; the general trend will be correctly shown.

Finally, it has, of course, been assumed that the plant manager maintains clear and logical income and expense statements, suitably arranged in accordance with the physical conditions of his own particular plant, and in which he has included an item generally called "Profit and Loss." The net of this statement for each month, therefore, is item ee on the balance sheet. The only comment on the operating statement deemed necessary in this discussion is to suggest that this operating statement consist of four columns—the first showing the figures of the month in question, the second, the total months to date of the accounting period, and the third and fourth columns corresponding figures for the prior year. Such a scheme is not particularly cumbersome and lends itself particularly well to valuable comparisons.

The writer is confident that any plant manager establishing such a system as has been described here and using it for one year would oppose its abandonment with the utmost vigor.

Manual on Emergency Repairs to Water Distribution Systems

This Manual is based on Bulletin No. 3 of the Emergency Water and Sewerage Committee of the Indiana State Board of Health and the Indiana Defense Council. Bulletin No. 3 was prepared by the Technical Committee of the Indiana Section of the A.W.W.A. The members of that Committee are listed at the end of the Manual.

Contents

1—Foreword 1889
2—Valves 1890
3—Emergency Materials 1891
4—General Pipe Data 1893
5—Emergency Repair Equipment 1895
6—Sterilization of Mains 1896
7—Availability of Personnel 1896
8—Main Repair Procedure 1897
9—How to Order 1899
10—Fire Hydrant Bypass Connections 1901
11—Typical Emergency Repairs 1902
12—Adapting Standard Mechanical Repair Parts to Emergency Conditions for Temporary Repair 1904
13—Illustrations of Some Equipment for Emergency Repairs of Major Main Breaks 1906
14—Bibliography of Manufacturers' Publications About Main Repair Equipment 1912
15—Main Repair Equipment and Manufacturers 1913

1—Foreword

This Manual is based upon, and follows closely, a bulletin prepared by the Technical Committee of the Indiana Section of the American Water Works Association and edited by the Emergency Water and Sewerage Committee of the Indiana State Board of Health and the Indiana State Defense Council. References to A.W.W.A. publications have been added and some material which duplicated previous A.W.W.A. publications has been deleted from this bulletin. Added also are the products of some companies, especially those remote from Indiana. The primary purpose of this

Manual is the same as was that of the bulletin—to supply water works men with information which can be used in maintaining service during disaster. For the most part, however, the contents simply outline good operating practice and if observed will prove helpful in the routine operation of a water works system.

This Manual, like the Indiana Bulletin, does not attempt to cover all possible methods of repairing mains nor is it to be inferred that the specific products mentioned herein are recommended to the exclusion of other similar products. The Manual shows proved methods for making permanent main repairs quickly as well as methods for making temporary repairs. These methods may have to be modified to fit local needs and the materials at hand.

Products cited are in all cases those of Associate Members of the A.W.W.A., unless no Associate Member is known to manufacture a given product, in which case a non-member manufacturer is cited.

The Association is indebted to Eugene T. Cranch, Manager of the New Rochelle, N.Y., Water Co., for review of the information as organized for JOURNAL publication.

2—Valves

Each valve in the distribution system should be operated at least once annually, and any defects found should be repaired promptly. The valve box lid should be kept raised to grade and free from soil or pavement coverage, so that the valve is readily accessible.

The location of valves in a water distribution system must be definitely known and all valves, the locations of which are not definitely known, should be checked at the earliest opportunity. It is suggested that duplicate sets of valve records, giving information as to size, make, type of valve, number of turns to operate and direction of operation, should be kept. Valve records should be kept in a manner to permit making copies for the use of maintenance and repair crews. Duplicate sets should be kept at different locations to minimize their possible destruction. For the two recommended methods of keeping valve records—the "plat and list" method and the "intersection sheet" method—see the A.W.W.A. "Recommended Practice for Distribution System Records" (Jour. A.W.W.A., **32**: 181 (1940), or in separate reprint form). It is strongly recommended that a definite record be maintained on the valve card as to the direction of operation by a designating symbol or marking. This should also be placed on all valves which operate in an opposite direction from the majority of the valves in the system. For example, if the majority of the valves in the system are referred to as right hand valves,* the underside of the valve

* The reference "right hand valve" is usually made to indicate a valve whose stem must be turned counter-clockwise to open.

box caps of left hand valves should be painted a distinguishing color. All employees who would be at all likely to operate valves should be advised of this marking.

It is realized that many water works properties will not be able to prepare a complete record at this time; however, there can be developed a record which indicates all known authentic information; and as valves are uncovered or discovered from time to time, this information can be added to the records.

A record of the number of turns necessary to open and close the valve to water tightness is important in the detection of the tendency of the valve to underseat or overseat as it becomes worn or corroded.

A sufficient number of valve wrenches or keys should be provided in various locations throughout the property so that these may be readily available without the necessity of returning to the shop for a wrench of different size or length.

A further elaboration of the valve record system should indicate the territory and the number and location of the hydrants affected by the valve closure of a section which has been shut down for emergency repairs. This information should immediately be relayed or referred to the local fire, civilian or military departments in charge of the particular situation. In general the recommendations concerning valve maintenance should be followed in the case of fire hydrants.

Unless the hydrants are always in good working order they are of little use.

Special attention should be given to the area necessarily shut off from the water supply by the closure of valves if a main break should occur at any one place.

3—Emergency Materials

Every water property should maintain an adequate supply of each size of pipe installed in the distribution system. An ample stock of emergency fittings such as couplings, sleeves, split sleeves, complete valve replacements, bends, caps, plugs, hydrant repairs, etc., should be maintained at all times.

It is not advisable to concentrate all of the available emergency materials in only one location on any property, especially if the entry to that location is from only one direction, which might be closed by debris during an air raid. Care should be exercised in the selection of storage points so that materials are not lost by theft or through unauthorized removal.

It is also advisable to keep the employees and automotive equipment dispersed.

A further description of recommended repair materials which should be available will be included in the later sections on main repair procedure.

It is not possible to set down any broad statements indicating the adequate or minimum stocks of materials to be kept on hand. Minimum stocks can be ascertained only by a careful study of these procedures coupled with the superintendent's knowledge of his distribution system.

It is recognized that the procurement of many needed materials is now very difficult and that this will affect the minimum stocks. In cases where

TABLE 1

Outside Diameters of Cast-Iron Pipe in Inches

(Before ordering material for any pipe, it is always advisable to check outside diameter in the field—if that is possible.)

NOMINAL PIPE SIZE	A.W.W.A. STANDARD (1908)*				A.S.A. STANDARD (1939)†			
	Class							
	A	B	C	D	100	150	200	250
3						3.80		3.80
4	4.80	5.00	5.00	5.00		4.80		4.80
6	6.90	7.10	7.10	7.10		6.90		6.90
8	9.05	9.05	9.30	9.30		9.05	9.05	9.05
10	11.10	11.10	11.40	11.40		11.10	11.10	11.10
12	13.20	13.20	13.50	13.50		13.20	13.20	13.20
14	15.30	15.30	15.65	15.65	15.30	15.65	15.65	15.65
16	17.40	17.40	17.80	17.80	17.40	17.80	17.80	17.80
18	19.50	19.50	19.92	19.92	19.50	19.92	19.92	19.92
20	21.60	21.60	22.06	22.06	21.06	22.06	22.06	22.06
24	25.80	25.80	26.32	26.32	25.80	26.32	26.32	26.32
30	31.74	32.00	32.40	32.74				
36	37.96	38.30	38.70	39.16				
42	44.20	44.50	45.10	45.58				
48	50.50	50.80	51.40	51.98				

* From p. 8, A.W.W.A. Standard Specifications for Cast-Iron Water Pipe and Special Castings, adopted May 12, 1908.

† See American Standard Specifications for Cast-Iron Pit-Cast Pipe for Water or Other Liquids—A21.2–1939, for complete figures for various class thicknesses.

stocks have been depleted and where replacements cannot be obtained, the individual must devise repair methods with materials available.

Since the Manual was first prepared, the mutual aid co-ordinators in various states have undertaken to operate clearing houses of information related to surplus materials and their emergency use by water works needing them. The recent amendments to Preference Rating Order P-46 (November 1942) make the operation of mutual aid necessary for the exchange of surplus inventories.

4—General Pipe Data

It is extremely important that a definite record of the main location and a complete description of the main be available for maintenance and emergency repair crews. (See A.W.W.A. "Recommended Practice for Distribution System Records" for data relating to description of mains on both comprehensive maps and on Sectional Plats.) The nature and the depth of cover over mains constitute information which, if properly recorded and accessible, may be used to expedite assignment of crews and equipment for repairs. Such information should be obtained whenever any section of the distribution mains is uncovered.

TABLE 2

Outside Diameters of Steel Pipe in Inches

(From pp. 23–4, A.W.W.A. Standard Specifications for Steel Water Pipe of Sizes of 4 Inches up to but Not Including 30 Inches—7A.4–1941)

NOMINAL PIPE SIZE	OUTSIDE DIAMETER
4 id.	4.500
5 id.	5.563
	6.000
6 id.	6.625
	8.000
8 id.	8.625
	10.000
10 id.	10.750
	12.000
12 id.	12.750
14 od.	14.000
15 od.	15.000
16 od.	16.000
17 od.	17.000
18 od.	18.000
20 od.	20.000

Such a record will be of considerable value in ordering proper repair materials and will tend to keep stocks of repair materials at a minimum. This record will also make certain that the proper material is on hand for making repairs.

Checking of flow whenever a main is cut is desirable in that it discovers any errors in the main maps relative to tie-ins. This can be done by operating the valves near the break and observing the flow. If, according to the distribution system map, there should be a flow of water at the point at which the repair is made when a certain valve is opened, and the flow does not occur when that valve is operated, the source of trouble should be located and corrected. Often, by following this procedure, it will be

discovered that some valves may have been closed for years, causing an artificial dead end which reduced fire flows materially.

Tables 1–3 show the outside pipe diameters for all types of pipe—A.W.W.A. (1908) Standard (Classes A, B, C, D) of cast-iron pipe and

TABLE 3

Outside Diameters of Asbestos-Cement Pipe in Inches

(The figures given below are those for the machined section of currently produced pipe. For the unmachined outside diameters, add a minimum of $\frac{1}{4}$ in. Because outside diameters of certain sizes of older lots of pipe vary from current lots, it is advised that the ends of both Transite and Century pipe be measured and the outside diameters recorded for planning possible repairs.)

NOMINAL INSIDE DIAMETER	TRANSITE PIPE			
	Class			
	50	100	150	200
3	3.66	3.70	3.88	4.20
4	4.66	4.70	4.85	5.20
6	6.72	6.76	6.95	7.50
8	8.84	8.88	9.15	9.76
10	10.88	11.18	11.70	12.20
12	12.96	13.36	13.96	14.48
14	15.04	15.56	16.26	16.88
16	17.12	17.76	18.50	19.30
18	19.18	19.94	20.78	21.74
20	21.26	22.14	23.06	24.18
24	25.38	26.50	27.64	28.96
30	31.80	33.08	34.58	36.24
36	38.18	39.66	41.60	43.48

NOMINAL INSIDE DIAMETER	CENTURY PIPE		
	Class		
	100	150	200
3	3.88	3.98	4.06
4	4.96	5.06	5.20
6	7.02	7.24	7.50
8	9.04	9.38	9.82
10	11.18	11.70	12.20
12	13.36	13.96	14.48

A.S.A. (1939) Standard (Classes 100, 150, 200, 250) of cast-iron pipe, A.W.W.A. (1941) standard steel pipe and asbestos-cement pipe—by classes of working pressure. If special fabricated steel pipe is used in a distribution system, Table 2 on steel pipe should be disregarded and definite measurements made of the exact outside diameter of the pipe.

5—Emergency Repair Equipment

A partial list of suggested equipment which should be available is shown below:

Blocking or cribbing
Portable trench pump with suction and discharge hose and extra parts
Portable hand pumps and extra parts
Portable lights and extra parts
Trench jacks and braces
Portable air compressors
Paving breakers, hammers, extra parts
Acetylene cutting equipment
Tripod and hoist
Chain tongs
Portable pipe vise
Barricades
Lead working equipment:
  Joint runners
  Yarning iron
  Calking tools
  Lead pot with fuel and joint material

It is further recommended that each local superintendent maintain a contact with other local utilities, contractors and manufacturing concerns where an extra supply of pumps, equipment, etc., could be obtained on relatively short notice.

An ample supply of hose should at all times be available so that connections to auxiliary supplies can be completed or so that a temporary bypass can be extended from one hydrant to another, thus bridging a shut-off section. This latter procedure would allow water service to an adjacent section to be continued during emergency main repairs (see Fig. 1).

It is recommended that fully equipped tool carts be available so that no time need be wasted during the stress of emergency to supply the emergency repair gang with the proper small tools and equipment necessary in the performance of their work. A suggested list of contents is given below:

First aid kit
Shovels
Picks
Clean-out tongs
Point tongs
Heavy hammer
Brick hammer
Large reamer
Tap wrench—tap and drill for stop box
Spout oil can
Wire brush
Large file
Pipe cutting equipment for minimum to maximum pipe sizes
Hacksaws
Chisels and sledges
Wheel cutters
Bucket
Metal folder (containing system map, valve records, etc.)
2-gal. kerosene can
Tunnel bar
Cape chisel
Cold chisel
Goggles
50-ft. tape
Soap can and brush (for soaping mechanical joint parts and gaskets)
Flashlights
Screw driver, medium size
Simple leak detecting equipment
Tarpaulin
Axe
Boots
Red flags
Lanterns
Wrenches for mechanical joint work
Pipe wrenches—all sizes
Keys—Meter box
  Stop cock
  Wheel valve
  Nut valve
  6-inch monkey wrench
  Fire hydrant wrench
Dipping needle
Pipe joint compound
Calcium hypochlorite, chlorinated lime or liquid chlorine
Equipment for feeding the above

6—Sterilization of Mains

It is extremely important that, whenever service is interrupted because of emergency repairs, steps be taken to provide some means of sterilizing the section affected. It is necessary to sterilize the main at the point where the repair is made. See Sec. 17 (pp. 22–25)—"Chlorination of Completed Pipe" in the A.W.W.A. "Standard Specifications for Laying Cast-Iron Pipe," for sterilization procedure for newly laid mains.

C. H. Billings of the Texas State Dept. of Health has thoroughly reviewed the subject of sterilization of new and repaired mains (Jour. A.W.W.A., **34:** 1777 (1942). Henry Berry has described the sterilization of both small and large mains in London (Jour. A.W.W.A., **34:** 1318 (1942). A review of these and other articles will help the superintendent plan his emergency sterilization procedures to be consistent with the equipment and personnel available to him.

Under emergency conditions, most authorities recommend a dose of approximately 50 ppm. for sterilization of repaired mains. The chlorine can be introduced into the pipe:

1. By placing dry hypochlorite into the pipe when the repair is made
2. By pumping hypochlorite into the pipe as it is being filled
3. By injecting chlorine solution into the pipe by using a chlorinator
4. By injecting chlorine gas directly into the main.

The first procedure is widely used, but is ineffective unless proper precautions are taken. If the dry powder is used, a sufficient amount must be placed in the pipe to produce a residual in excess of 50 ppm. when the main is filled with water, and the main must be filled very slowly to prevent the solution from being washed to the downstream end of the pipe.

Methods No. 2 and No. 3 are effective and are recommended provided the flow is regulated to give the desired chlorine residual.

Method No. 4 is satisfactory when equipment capable of controlling the flow of chlorine is used.

7—Availability of Personnel

In every water utility there should be established an operating program which will provide for the availability of trained personnel at all times so that prompt response may be made to emergency calls. Until such time as bombings occur, it seems advisable to divide the personnel into as many units as feasible and to require each unit to hold itself definitely available and responsible for emergency calls for one or more scheduled nights each week. No personnel of a utility, involved in maintenance repair work, should at any time participate in other civilian defense emergency work or any work that would in any way curtail his availability to the utility at a time of emergency.

It is suggested that plans for the prompt reporting of water leaks or of hydrant damage be worked out through co-operation with the municipal or military authorities.

In one city having police cars equipped with two-way radio systems, a plan has been set up in co-operation with the police department, in which valve keys and valve records are kept at police headquarters. The names of responsible key men are on file, together with their addresses and phone numbers. The key man contacted can then obtain the valve keys and valve records from either the police headquarters or the distribution shop, whichever is the more accessible, thereby being able to make a sectional shut-down in the shortest possible time. All key men affected by this system have single-line telephones installed in their homes.

8—Main Repair Procedure

In considering the following discussion on main repair procedures, it must be remembered that this Manual deals with *emergency* repairs.

The speed necessary to put damaged sections back in service can be determined only by the local superintendent.

The reader will note that the repair of mains by mechanical joint fittings has been stressed. This has been done, not because it is believed that they are preferable to other types, but because they usually provide a rapid means of repair. British experience has shown that mechanical joint repairs are more satisfactory than lead joints, when rapid repairs are required. Lead or sulfur compound joint fittings have not been considered primarily, since it is felt that most distribution system crews are familiar with these materials.

During the war it will probably become more and more difficult to obtain special fittings, especially those of the mechanical type, so it may be considered advisable to save these special fittings for emergencies when quick repairs are needed, and to use the lead and sulfur compound fittings when time is not such a vital consideration.

Care must also be exercised in ordering. Incorporated in this section, as an example, is the information requested by one manufacturer when repair fittings are ordered. This ordering information should be studied carefully and used in ordering mechanical joint type fittings from any manufacturer. Its use will enable the manufacturer to supply the proper fitting without undue delay and unnecessary correspondence. In ordering, the maximum and minimum nominal pipe sizes in which the particular fitting is made should be obtained from the manufacturer's catalogs. A careful reading of a manufacturer's catalog, from which a purchase is to be made, will save correspondence and delay. Upon request, the manufacturer will, in most instances, specify the proper bolts, gaskets and coatings if you give him sufficient information. It is urged that all gaskets be

either lead-tipped or armored. This will assure an unbroken electric circuit if thawing is necessary.

A variety of specials can be built up from fittings in stock. For instance, to insert a 4-in. steel section in a 4-in. cast-iron main, there may be on hand one 4-in. steel and one 4-in. cast-iron mechanical joint coupling, neither of which will fit the conditions; but by halving the middle rings of both types and welding together a half-section of each, two couplings to take care of this situation can readily be made. It should, of course, be ascertained that the welder doing the job is capable.

Bell-joint leak repairs on oversized bells may be made by substitution. For example, a 4-in. main having oversized bells can readily be repaired with a 4-in. bell-joint clamp, by replacing the anchor ring with an anchor ring from a 6-in. clamp. Exercise of ingenuity as illustrated in the two examples above will solve many repair problems. The makeshift fittings can be relied upon for permanent repairs if sufficient care be exercised in requiring that good workmanship be built into them.

In this Manual an attempt is made to show methods of making quick emergency repairs that are also permanent. In some instances this is not possible, where restoration of service must be made in the shortest possible time. Water works men are not advised to consider permanent, a repair where a much smaller diameter section of pipe replaces original pipe, nor is it recommended that very long longitudinal splits repaired with a series of split sleeves be considered permanent.

The experiences in Great Britain indicate that permanent construction should be made where possible, as the temporary construction takes almost as much time as the permanent work, and must be done over. Where temporary construction is imperative, however, bridging of craters by smaller diameter pipes has been reported successful in England.

At times, the flow of water cannot be properly controlled; therefore, it is recommended that fittings be tapped in order that water may drain through these tappings during installation.

It is here emphasized that any particular manufacturer's products are not recommended; even though this Manual contains much information taken directly from numerous manufacturers' publications.

At the writing of this Manual a limited number of manufacturers have developed fittings which can be used to fit various outside diameters of cast-iron pipe. It is expected that other manufacturers will recognize the need and develop all-purpose fittings.

It is realized that in the performance of emergency work, speed is essential, and also that stress sometimes causes hasty decisions. A calm survey of the situation may indicate that a better job can be done more quickly than a poor one and a permanent repair made instead of a temporary one. In line with this statement, it is believed that if the little extra time necessary to square up jagged ends is taken, when possible, it

will never be regretted. Shown later are drawings of suggested methods of main repairs that are self-explanatory.

The illustrations in this Manual give a visual picture of the wide scope of the fittings available for quick repairs of major main breaks. Equipment for repairing small holes in mains, bell joints, threaded and welded joints, broken bells, service connections, etc., is not illustrated in this presentation. A number of the manufacturers' catalogs listed in the latter portion of this Manual show these smaller repairs in detail.

9—How to Order

Mechanical joint products are listed below. Opposite each product is a series of numbers. Each number stands for certain ordering information as given under the "Key." On all orders the information called for in column headed "Essential Information" should be given. The information requested in the next column headed "Information Sometimes Required" may be included or not, depending upon the individual order. If you are sure that a previous order of exactly the same material or fitting has been made, even 10 years previously, mention this fact to the manufacturer, as this will facilitate ordering.

Type of Mechanical Joint Fitting	Essential Information	Information Sometimes Required
	(See Key on Page 1909)	
Couplings:		
For Steel Pipe	1,2,9,14,15,16,17,41	18,19,20,21
For Cast Iron Pipe	1,2,4,9,14,15,16,17,41	18,19,20,21
Reducing Couplings	1,3,9,10,14,15	4,5,18,19,20,21
Long Sleeves	1,2,9,14,15,17	4,5,13,19,20,21
Line Caps	1,2,9,14,15	4,5,16,17,19,20,21,26
Clamps:		
Band Clamps	1,2,9,14,15	4,5,19,21,30,31,32
Collar Clamps	1,2,9,14,15	19,21
Porous Weld Clamps	1,2,9,14,15,28	19,21
Saddle Clamps	1,2,9,14,15	30,32
Screwed Fitting Clamps	1,2,9,14,15,29	19
Split Repair Clamps	1,2,9,10,14,15	4,5,19,21,30,31,32
Split Repair Sleeves:		
Cast Split Sleeves	1,2,4,9,14,15	19,33
Joiner Parts, Sets	1,2,12,14,15	4,5,19
Gaskets, Bolts, Wrenches:*		
Extra Gaskets for Couplings, Long Sleeve and Fittings	1,2,12,14	4,5,20,23,24
Extra Gaskets for Clamps, Split Sleeves and other Products:		
Clamps	1,2,12,14	4,5,32,34
Split Sleeves—All Styles	1,2,12,14	4,5,34,36,37,38,39
Extra Gaskets for Obsolete Products	1,2,12,14	4,5,34,36,37,38,39
Machine Bolts	1,12,19,40	21
Wrenches	Order by Number	

* Note: Mention a second preference on gaskets, to give the manufacturer some leeway if he does not have that particular gasket on hand.

Bell Joint Clamp: 1,2,4,9,14,15,19

Range of adjustment is as follows: Clamps as listed will fit standard bell joints on the following standard sizes of bell and spigot, cast-iron pipe:

A. G. A. Pipe: 4 to 48 in. inclusive

A.W.W.A. Pipe:
3 to 24 in. inclusive—Classes A, B, C, and D
30 in.—Class A, B, and C
36 to 48 in. inclusive—Classes A and B

For conditions where a stock clamp will not meet the requirements (as in the case of variations from standard that are too large), special clamps are supplied. In all cases, except for the standard sizes listed above, the proper clamp that should be supplied and its price can be determined only after receipt of measurements of bell joint.

Nipples (Concentric & Eccentric Types):

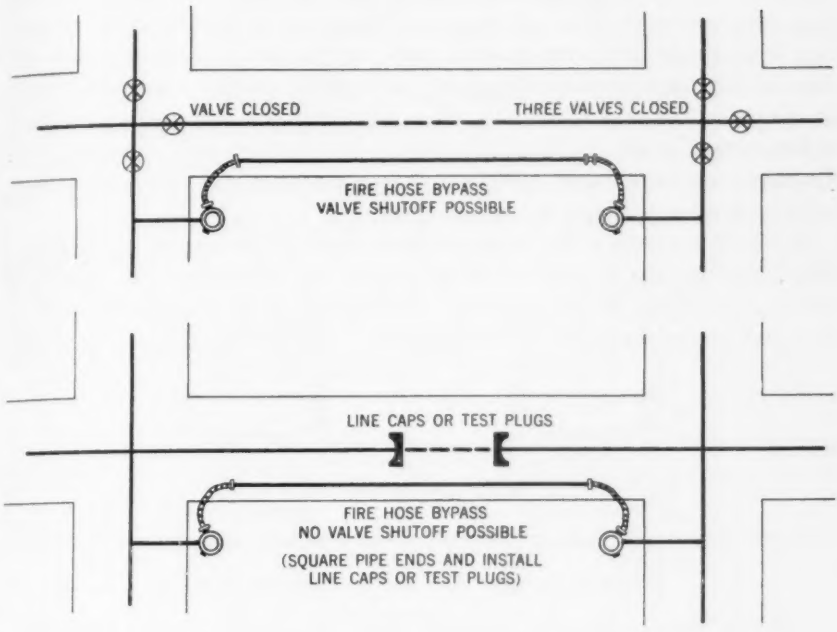
This product will be furnished promptly upon receipt of the following specifications:

1. Quantity of nipples desired.
2. Nominal size and outside diameter of both pipe ends to be connected.
3. Kind of pipe on both ends.
4. Maximum working pressure.
5. Type of end desired on nipple—plain, threaded or beveled.
6. Type of nipple—concentric or eccentric.
7. Weight—Standard, Extra Strong or Double Extra Strong.

Key

1. Quantity desired
2. Nominal size and outside diameter of pipe
3. Nominal size and outside diameter of both pipe ends to be connected
4. Class of cast iron pipe
5. Kind of pipe—steel, cast iron, etc.
9. Style number and name of product being ordered
10. Type number
12. Style number, type number (if used), and name of product with which used
14. Service—gas, water, air, oil, etc.
15. Maximum working pressure
16. Thickness of middle ring
17. Length of middle ring
18. Whether pipe stops are to be removed from middle rings
19. Type of bolts to be furnished
20. Type of gasket desired
21. Type of protective coating or primer, if any, to be applied
23. Average and maximum working temperature of contents of line
26. If vent and plug are to be left off, or placed off-center, or if head is to be concave, this must be specified
28. Outside diameter and width of weld bead
29. Type of fitting to be clamped
30. Type of break-hole, split, etc.,—and its dimensions
31. Length (along pipe) of clamp desired
32. Whether cone gasket or flat sheet-rubber gasket should be included
34. Thickness and length of gasket cross-section
36. If split sleeve gasket, whether for end or side pack
37. If split sleeve side gasket, length of gasket
38. If split sleeve side gasket, whether grooved or flat
39. If flat side gasket, number of bolt holes required
40. Diameter, and length measured from under side of heads
41. Couplings should be ordered without pipe stops if to be used for repairing jagged breaks

10—Fire Hydrant Bypass Connections



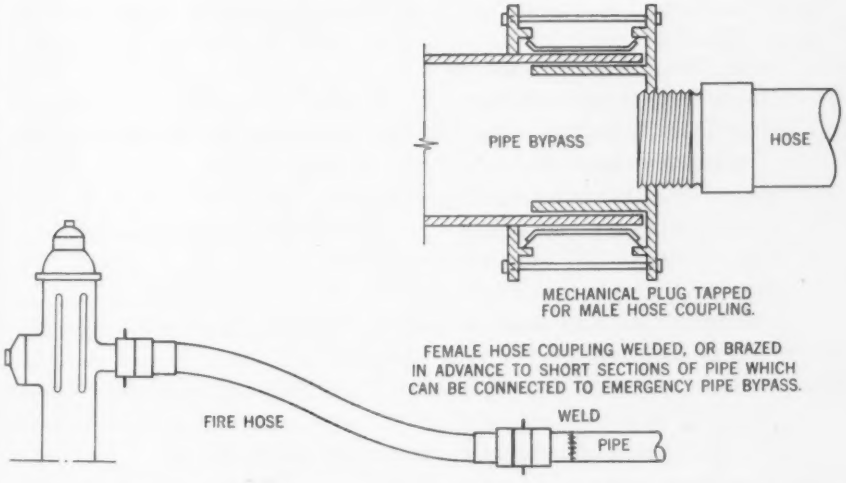


FIG. 1. Bypassing by Hydrant Connections and Methods of Connecting Hose to Pipe

11—Typical Emergency Repairs

Because British practice has so definitely indicated that it is preferable to make permanent repairs it is assumed in the first two cases below that time is available to square-up ends, and that the same size of pipe is available, permitting a permanent repair. Also given are other methods which the water works superintendent will wish to have in mind when the time and materials available in an emergency dictate their use. Section 15 of the Manual gives a list of A.W.W.A. Associate Members who make equipment generally referred to in this Section.

In Fig. 2 is shown a case where time is available to square up ends and eliminate the jagged portion, making sure the "squaring" is done well behind any cracks in the pipe line. A length of pipe of the same outside diameter as the damaged line is available. For joining the new pipe, the

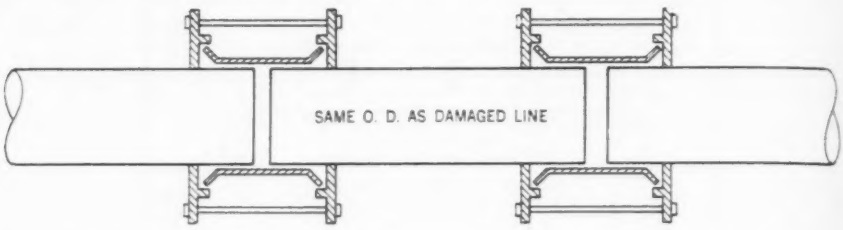


FIG. 2. Use of Same Nominal Size of Pipe and Same Outside Diameters

superintendent will want to choose from the following, keeping in mind the speed of insertion and availability of the coupling, clamp or sleeve:

(a) Steel Pipe—Use Styles No. 38 and No. 40 Dresser Couplings (without stop)
Smith-Blair flexible coupling
Baker flange type couplings

(b) Cast-Iron Pipe—Use Styles No. 53, No. 40 or No. 38 Dresser couplings (without stop)
Smith-Blair flexible couplings
Baker flange type couplings
Baker Double "H" split coupling
Skinner Bomb Crater Clamp
Cast-iron split and solid sleeves—see list of manufacturers in Section 15 at the end of this Manual.

(c) Asbestos Cement Pipe: The first consideration is usually the removal of an entire length of asbestos-cement pipe and replaceing it, using the manufacturers' standard couplings. The use of solid or split cast-iron sleeves or solid asbestos-cement sleeves will be a prime consideration. The superintendent may wish to con-

sult the manufacturer on the possible use in emergencies of certain of the above mentioned mechanical or flexible couplings. Careful planning may be necessary to utilize available couplings with the available machined ends and lengths or unmachined broken ends of asbestos-cement pipe. The superintendent must consider carefully the type of equipment, the kind of personnel and the amount of time available in an emergency.

In planning to use certain of the above equipment, the superintendent must keep in mind when replacing a portion of a length of pipe whether he is working with unmachined asbestos-cement pipe and ends or machined ends or lengths.

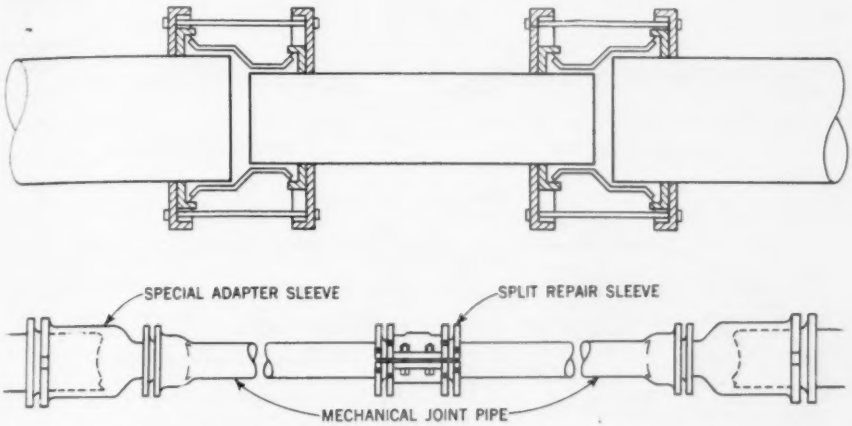


FIG. 3. Use of a Smaller Size of Pipe for Temporary Repair
FIG. 4. Emergency Repair Fitting as Developed by James B. Clow & Sons

A case varying from Fig. 2 is the replacement of a portion of a broken cast-iron or steel main with the same nominal size of pipe but of a different outside diameter. Equipment to be considered for this operation is:

Style No. 62, Type 1 Dresser couplings
Smith-Blair flexible couplings
Baker flange type couplings
Skinner Bomb Crater Clamp

Asbestos-cement pipe may be repaired primarily with split or solid cast-iron sleeves or adaptors and Transite adaptors, though in emergencies the superintendent will want to consider the possible use of couplings cited above.

When the same size of pipe is not available, a temporary repair may be made as shown in Figs. 3, 4, and 5.

Figure 3 shows the use of equipment such as Style No. 62 Dresser Couplings. Figure 4 shows emergency repair fittings such as those developed by James B. Clow & Sons, and in Fig. 5 are shown straight and reducing sleeves such as those developed by the American Cast Iron Pipe Co. Figure 6 shows the use of an adapter sleeve and of strap iron clamps in repairing mains, as set forth in "Protective and Remedial Measures for Sanitary and Public Health Engineering Services" (Proc. A.S.C.E., January 1942).

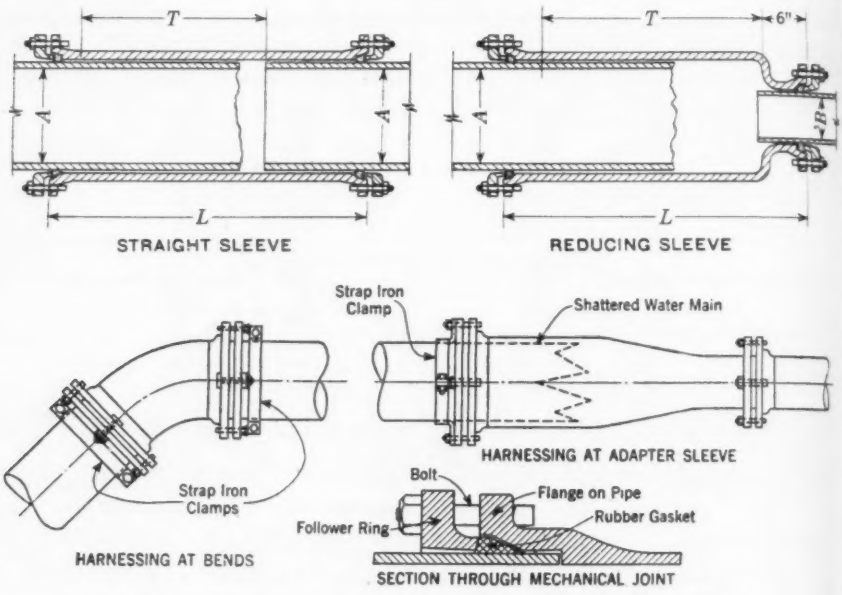
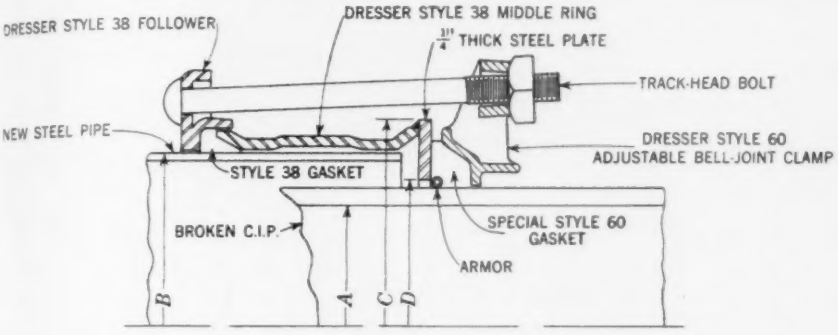


FIG. 5. Sleeves as Developed by American Cast Iron Pipe Co.
FIG. 6. Adapter Sleeve for Repairing Water Mains (Proc. A.S.C.E., Jan. 1942)

12—Adapting Standard Mechanical Repair Parts to Emergency Conditions for Temporary Repair

Fittings for two general sizes of repairs possible with materials available have been developed by the Dresser Mfg. Co. as described in a reprint from the November 1941 American Gas Association Journal. Figure 7 herewith is suitable for sizes 3- to 14-in. cast-iron pipe, inclusive. In this design the adapter is made from a regular coupling middle ring, to which a steel plate is welded to act as a bearing surface for the clamp gasket. Steel pipe of standard outside diameters, as given in Table 4 are used for the replacement sections, intermediate joints being made with regular Dresser couplings. A regular coupling gasket and follower make the seal between

steel pipe and adapter. Through bolts from clamp spigot ring to coupling follower compress both gaskets simultaneously. In some sizes it will be necessary to cut special holes in the coupling follower to match the number of holes in the clamp, as these do not coincide in every instance. The holes can be burned out with a torch, or if the followers are ordered as parts, they can be specially punched at the factory.



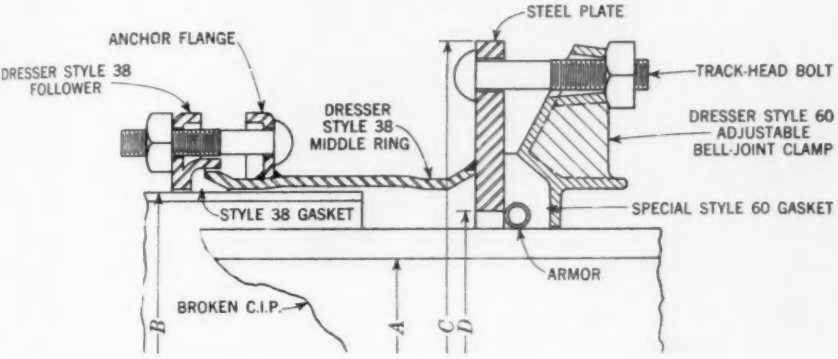


FIG. 7. Fitting for 3- to 14-Inch Pipe
FIG. 8. Fitting for 16- to 24-Inch Pipe

Figure 8, for sizes 16-in. and larger cast-iron pipe, is similar to Fig. 7, except that through bolts are not used, the difference in bolt circle diameters between coupling follower and clamp spigot becoming so great that the bolt angularity would be excessive. Therefore, the adapter plate is made large enough to serve as an anchor for the clamp, an anchor flange is welded to the middle ring, and short bolts are used at each end. The anchor flange is easily made by torch-cutting a regular coupling follower. The fittings in Fig. 7 could be made in larger sizes by using larger steel pipe, but it is, of course, desirable to keep the size of replacement pipe to a minimum.

The fittings are readily made from standard parts either by the manufacturer or in the water company's own shop. The only part not ordinarily carried in stock by most water companies is the special armored gasket. The latter, of course, should be stocked in sufficient quantities to meet any emergency.

While Tables 4 and 5 mention only steel pipe, this method should prove adaptable for use with various types of material.

TABLE 4

(All Dimensions in Inches)

"A" C.I.P. SIZE DIAMETER	"B" STEEL PIPE O.D.	MIDDLE RING	FOLLOWER THICKNESS	STYLE 38 GASKET SECTION	BOLTS	STEEL PLATES	
						Dia. "C"	Dia. "D"
3	$5\frac{9}{16}$	$\frac{1}{4}$ x 5	$\frac{1}{4}$	$\frac{1}{2}$ x 1	$4\frac{5}{8}$ x 9	$6\frac{3}{4}$	4.085
4	$6\frac{5}{8}$	$\frac{1}{4}$ x 5	$\frac{1}{4}$	$\frac{1}{2}$ x 1	$4\frac{5}{8}$ x 9	$7\frac{3}{4}$	5.185
6	$8\frac{5}{8}$	$\frac{1}{4}$ x 5	$\frac{1}{4}$	$\frac{1}{2}$ x 1	$6\frac{5}{8}$ x $9\frac{1}{2}$	$9\frac{3}{4}$	7.285
8	$10\frac{3}{4}$	$\frac{1}{4}$ x 5	$\frac{1}{4}$	$\frac{1}{2}$ x 1	$6\frac{5}{8}$ x $9\frac{1}{2}$	12	9.485
10	$12\frac{3}{4}$	$\frac{1}{4}$ x 5	$\frac{1}{4}$	$\frac{1}{2}$ x 1	$8\frac{5}{8}$ x $9\frac{1}{2}$	14	11.585
12	16	$\frac{1}{4}$ x 7	$\frac{1}{4}$	$\frac{1}{2}$ x $1\frac{1}{8}$	$8\frac{5}{8}$ x 12	$17\frac{1}{4}$	13.685
14	18	$\frac{1}{4}$ x 7	$\frac{1}{4}$	$\frac{1}{2}$ x $1\frac{1}{8}$	$9\frac{5}{8}$ x 12	$19\frac{1}{4}$	15.835

TABLE 5

(All Dimensions in Inches)

C.I.P. SIZE "A" DIA.	STEEL PIPE O.D. "B"	MIDDLE RING	FOLLOWER THICKNESS	STYLE 38 GASKET SECTION	BOLTS		STEEL PLATE	
							Dia. "C"	Dia. "D"
16	20	$\frac{1}{4}$ x 7	$\frac{1}{4}$	$\frac{1}{2}$–$1\frac{1}{8}$	$12\frac{5}{8}$ x 4	$9\frac{5}{8}$ x $4\frac{1}{2}$	$25\frac{5}{8}$	17.985
18	22	$\frac{1}{4}$ x 7	$\frac{1}{4}$	$\frac{1}{2}$–$1\frac{3}{16}$	$14\frac{5}{8}$ x 4	$12\frac{5}{8}$ x $4\frac{1}{2}$	$27\frac{7}{8}$	20.125
20	24	$\frac{1}{4}$ x 7	$\frac{1}{4}$	$\frac{1}{2}$–$1\frac{3}{16}$	$14\frac{5}{8}$ x 4	$12\frac{5}{8}$ x $4\frac{1}{2}$	$30\frac{3}{4}$	22.26
24	28	$\frac{1}{4}$ x 7	$\frac{1}{4}$	$\frac{1}{2}$–$1\frac{1}{4}$	$16\frac{5}{8}$ x 4	$12\frac{5}{8}$ x $4\frac{1}{2}$	$34\frac{3}{4}$	26.53

13—Illustrations of Some Equipment for Emergency Repairs of Major Main Breaks

There are here illustrated some of the fittings which will prove useful in repairing breaks due to bomb hits. Fittings for repairing small holes in mains, bell joints, threaded and welded joints, broken bells, service connections, etc., are not illustrated. The superintendent should study the equipment available for such repairs by referring to the catalogs and material listed in Section 14 near the close of the Manual. Many of the manufacturers' bulletins show in detail the applications and procedures for using different kinds of fittings. For the complete listing of A.W.W.A. Associate Member manufacturers of repair equipment, see Section 15.

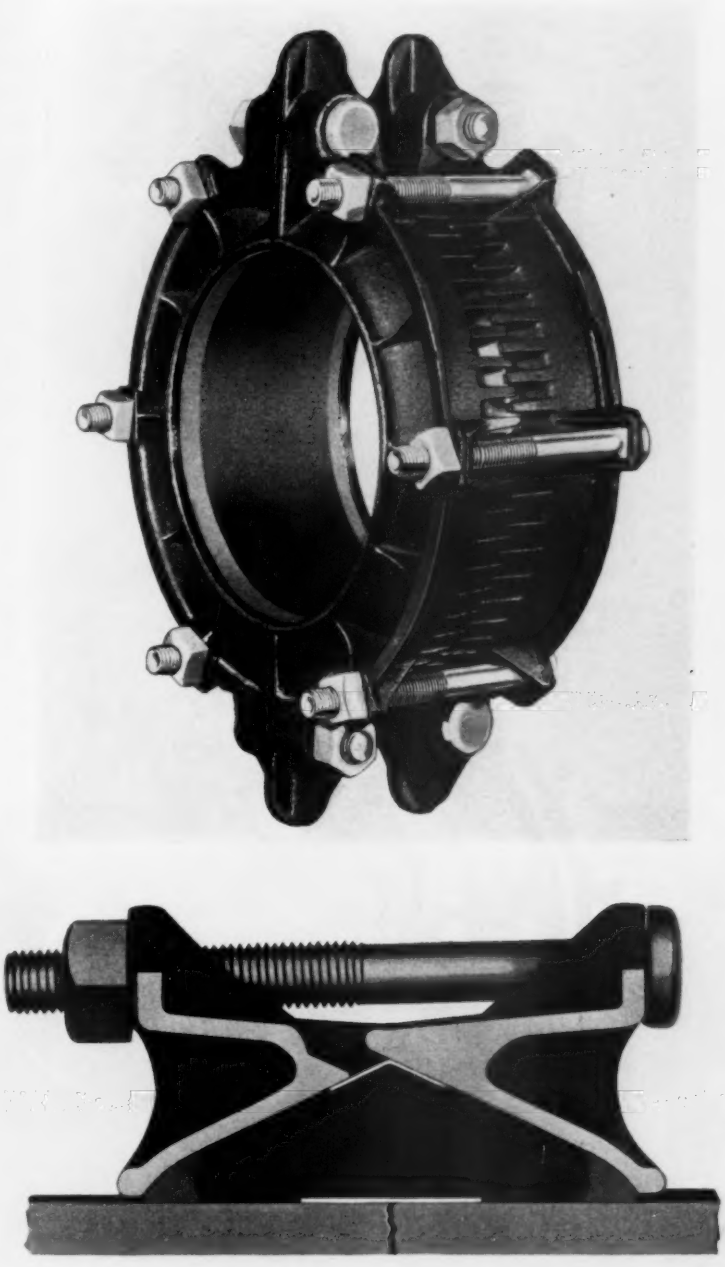


FIG. 9. Skinner Split Coupling Clamp—Model SC



FIG. 10. Dresser Adjustable Repair Sleeve—Style 82

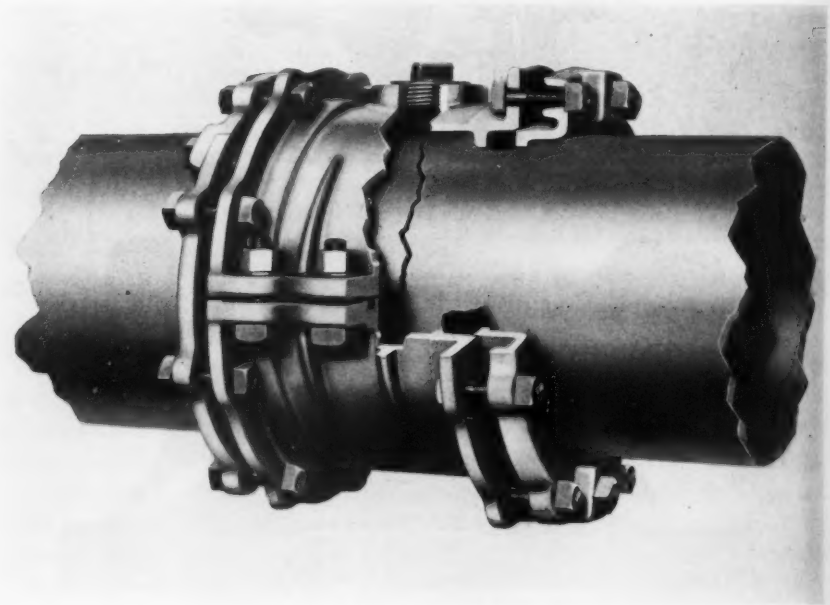
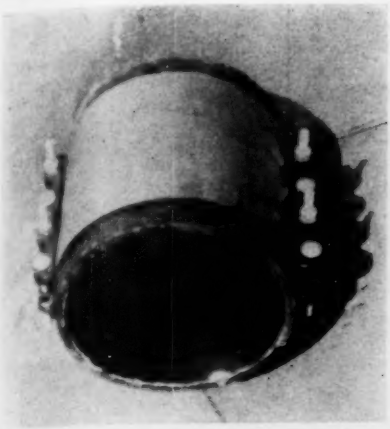


FIG. 11. Dresser Cast Repair Sleeve—Style 57



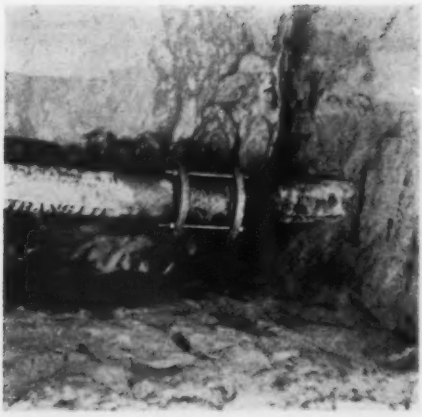
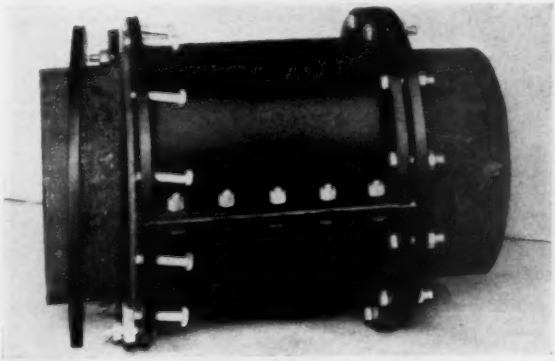


FIG. 12. Smith-Blair Full Circle Clamp Coupling
FIG. 13. Smith-Blair Flexible Coupling



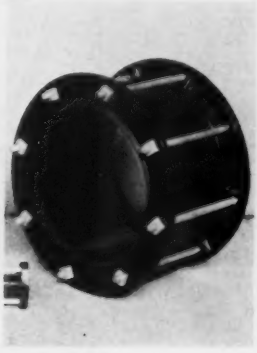


FIG. 14. Baker Double "H" Split Coupling
FIG. 15. Baker Flange Type Coupling

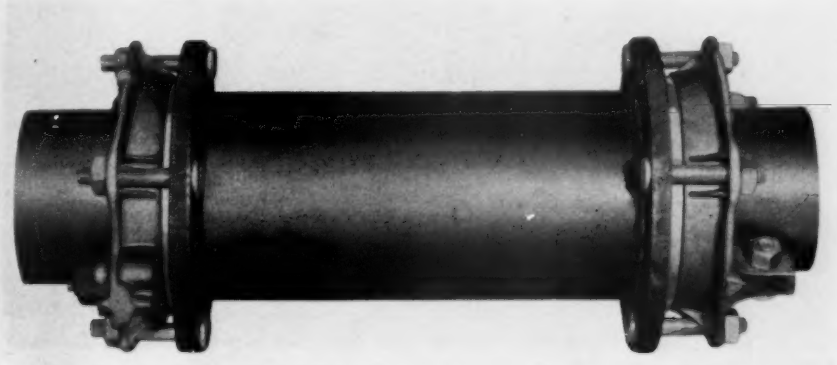
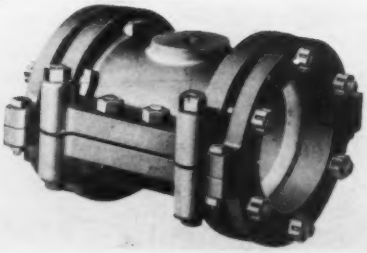


FIG. 16. Skinner Bomb Crater Clamp



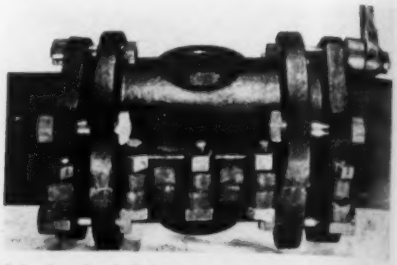


FIG. 17. Clow-National Mechanical Joint
FIG. 18. Acipco Doublex Simplex Split Sleeve



FIG. 19. So-called Standard Split Sleeve; this illustration is from the A. P. Smith Mfg. Co. Catalog No. 38. See list of manufacturers under "Sleeves" in Section 15 who make these or similar sleeves

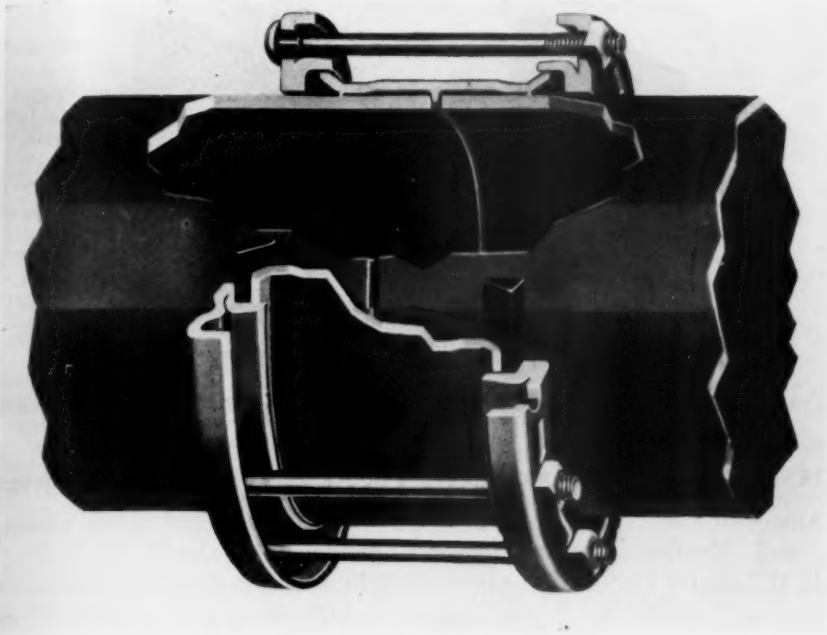


FIG. 20. Dresser Coupling—Style 38

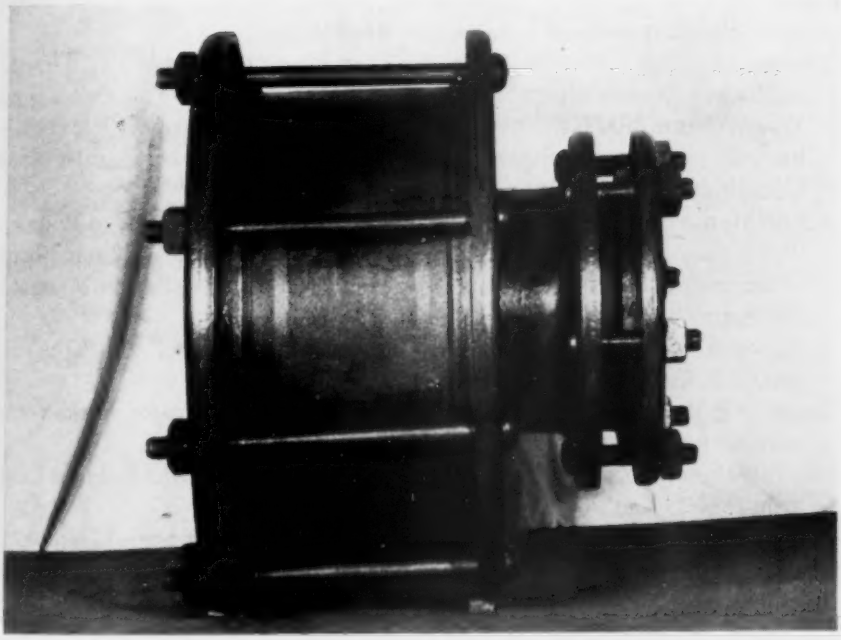


FIG. 21. Dresser Reducing Coupling—Style 62

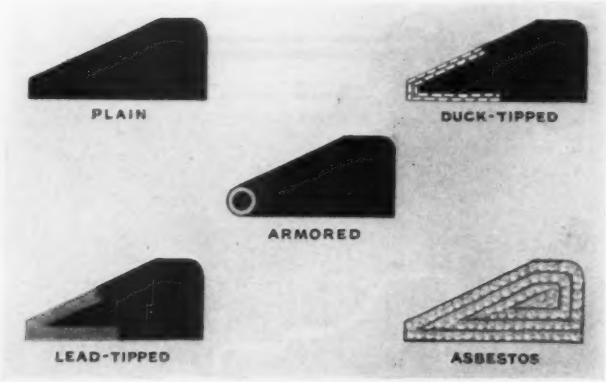


FIG. 22. Rubber Gaskets—Use Armored or Lead Tipped Only, if Thawing Will Be Necessary

14—Bibliography of Manufacturers' Publications Main Repair Equipment

American Cast Iron Pipe Co. "Doublex Simplex Split Sleeve Leaflet" and "Mechanical Joint Sleeves for Emergency Repairs."

R. H. Baker & Co. Catalog B—1942 Edition covers couplings and clamps.

Carson-Cadillac Co. "Stop Leaks!"—a bulletin on mechanical bell joint clamps; also a bulletin on corrosion-resistant bolts.

H. W. Clark Co. Catalog R (2nd Ed.): pipe cutters, water works tools.

James B. Clow & Sons. "Emergency Repair Fittings and Their Use;" and "Pipe Economy," Catalog No. 41, 312 pp.

Dresser Mfg. Co. "How to Join and Repair Pipe," Catalog 402B; "Dresser Adjustable Repair Sleeve," Form 4111D; "Here's How You Can Clamp Down," Form 3612H; "Now—the Armored Gasket," Form 3410; and catalog pages on Dresser Styles 57, 62, 82 and on "Dresser Regular Steel Coupling for Steel Pipe and Cast-Iron Pipe."

Johns-Manville. "Transite Pipe Repair of War Damage; Suggestions for Temporary Restoration and Permanent Replacement." 92-page book—DS Series 350; also, "JM Transite Pressure Pipe Installation Manual," DS Series 332.

Keasbey & Mattison Co. "Mains Without Maintenance" and "Instructions for Laying 'Century' Asbestos-Cement Pipe."

Joseph G. Pollard Co., Inc. Catalog No. 23A covers water works tools, such as hydrant wrench and spanner, pipe cutters, etc.

M. B. Skinner Co. "Repair Clamps, Service Fittings, for Steel and Cast-Iron Pipe"—Catalog No. 41.

Smith-Blair, Inc. General Catalog No. 3 covers couplings and clamps.

A. P. Smith Mfg. Co. Catalogue No. 38 Misc. covers pipe cutting machines, repair sleeves, and plugs.

(See also the catalogs or handbooks of all pipe foundry companies and others mentioned under "Sleeves" in Section 15 for standard sleeves.)

15—Main Repair Equipment and Manufacturers

Chorinators
Everson Mfg. Co.
Infilco, Inc.
Omega Machine Co.
Phipps & Bird, Inc.
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.

Clamps, Bell Joint
Carson-Cadillac Corp.
Dresser Mfg. Co.
Grinnell Co.
Pollard, Joseph G., Co., Inc.
Sherman Mach. & Iron Works
Skinner, M. B., Co.

Clamps, Pipe Repair
Baker, R. H., & Co., Inc.
Carson-Cadillac Corp.
Clow, James B., & Sons
Dresser Mfg. Co.
Mueller Co.
Sherman Mach. & Iron Works
Skinner, M. B., Co.
Smith, A. P., Mfg. Co.
Smith-Blair, Inc.

Flexible Joints
Central Foundry Co.
Chicago Pump Co.
Clow, James B., & Sons
Dresser Mfg. Co.
U. S. Pipe & Foundry Co.

Hypochlorinators
Bacharach, E. W., & Co.
Everson Mfg. Co.
Infilco, Inc.
Omega Machine Co.
Permutit Co.
Phipps & Bird, Inc.
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.

Leak Detectors
Clark, H. W , Co.
Ferguson, S. F.
Fisher Research Lab.
Nutting, H. C., Co.
Water Leak Detector Co.

Pipe Cutters
Clark, H. W., Co.
Pollard, Joseph G , Co., Inc.
Smith, A. P., Mfg. Co.

Pipe Joints, Mechanical
Carson-Cadillac Corp.
Clow, James B., & Sons
Dresser Mfg. Co.
Lock Joint Pipe Co.
Lynchburg Foundry Co.
McWane Cast Iron Pipe Co.
Multiplex Mfg. Co., Inc.
U. S. Pipe & Foundry Co.

Plugs, Removable
Clow, James B., & Sons
Crane Co.
Grinnell Co.
McWane Cast Iron Pipe Co.
Smith-Blair, Inc.
Smith, A. P., Mfg. Co.
Warren Foundry & Pipe Corp.

Pumps, Portable
Byron Jackson Co.
Chicago Pump Co.
De Laval Steam Turbine Co.
Edson Corp.
Homelite Corp.
Proportioneers, Inc.

Sleeves
American Foundry & Mfg. Co.
American Smelting & Refining Co.
Clow, James B., & Sons
Darling Valve & Mfg. Co.
Dresser Mfg. Co.
Grinnell Co.
Johns-Manville Corp.
Lynchburg Foundry Co.
M & H Valve & Fittings Co.
McWane Cast Iron Pipe Co.
Mueller Co.
Rensselaer Valve Co.
Sherman Mach. & Iron Works
Smith, A. P., Mfg. Co.
Smith-Blair, Inc.
U. S. Pipe & Foundry Co.
Warren Foundry Co.
Wood, R. D., Co.

Members of the Indiana Technical Committee

F. A. Schaefer, *Chairman*
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John L. Ford
Louis A. Geupel
W. E. Howland
E. F. Kinney
Paul Laux
Charles L. Link
S. J. Miller
Edwin Milligan
H. W. Niemeyer
P. H. Reardon
W. C. Shoemaker
A. G. Vinick
Clyde E. Williams

Emergency Alternate Provisions for Tentative Specifications for Cold Water Meters—Displacement Type—7M.1-T

THESE emergency alternate provisions are issued by the American Water Works Association, as of December 1, 1942, in accordance with special procedure in the interest of expediting procurement or conservation of materials during the period of national emergency. They are intended for use where they may be considered by the purchaser of the material as a permissible alternate for the specific application or use desired.

The following emergency alternate provisions, listed here by section and sub-section designations in the specifications, when specified, may be used as alternates in the A.W.W.A. Tentative Specifications for Cold Water Meters—Displacement Type—7M.1-T, and affect only the requirements referred to:

1–3.1 Revise the second sentence to read: "The outer case for all 2-in. and smaller meters shall be of bronze composition or of cast iron protected by a non-corrosive treatment."

1–3.2 Revise to read: "All external bolts or cap bolts, including washers, shall be of protective-treated iron or steel. (When breakable washers are used for frost protection, the bolts and washers shall be made of suitable materials.) Nuts shall be of ferrous material and shall be designed for easy removal after having been long in service."

1–3.5 Revise the first sentence to read: "Register boxes and lids shall be made of the same material as the top case, with the name of the manufacturer cast on the lid in raised letters." *

* UNOFFICIAL EDITORIAL COMMENT: The use of plastics in register boxes and lids may be considered by purchasers as an acceptable alternate to metal, provided that the manufacturer continues to place upon the meter adequate and lasting identification marking.

Revisions in Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs

FOLLOWING is a series of revisions to the Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs—7H.1–1941, adopted as standard by the A.W.W.A. June 26, 1941 and by the American Welding Society July 23, 1941. These revisions as approved by Committee 7H on Steel Standpipes and Elevated Tanks, Louis R. Howson, Chairman, were transmitted to the A.W.W.A. Board of Directors and the Water Works Practice Committee and approved by them as of October 1, 1942.

The revisions are listed here by their section and sub-section designations in the specifications:

2.11 (*b*) Revise the final phrase in the last line to read: "using the GA-60 classification." (This change will make the classification conform to the new numbering of A.W.S. specifications.)

3.02 (*d*) Revise the second paragraph to read: "For columns and struts of structural shapes, the projected area shall be calculated. Struts on the leeward side of the tower shall be assumed as being shielded 50 per cent by those on the windward side. In the case of columns and sway rods, the wind pressure shall be applied on the projected area of each member."

3.04 (*c*) To the end of this section, add: "It is not necessary to combine wind stress and earthquake stress, but to proportion each member for the larger of the two in combination with stresses produced by other causes."

5.06 To the end of this section, add: "These shall consist of struts connecting the foundation piers, or of structural members connecting the lower ends of the columns."

5.07 Revise the first paragraph to read: "Such members shall be designed to resist the wind load and the earthquake load if the latter is specified. It is not necessary to combine wind and earthquake loads but to design for the maximum stress produced by either force. If the projected centers of gravity of tension members do not meet the projected center of gravity of structural members at the center of gravity of the columns, proper allowance shall be made for the eccentricity."

11.05 (*b*) Revise (to remove ambiguity and to conform to late revision made by the A.W.S.) to read: "In joints subject to primary stress from weight or pressure of tank contents: One segment shall be cut from the first 10 ft. of completed joint welded by each operator. Thereafter, one segment shall be cut from approximately every 100 ft. of joint, except that if the sum of the lengths of vertical joints in any course is less than 100 ft., one segment shall be cut from one vertical joint in each course of cylindrical tank shells. It is permissible to test two operator's work with one segment if they weld opposite sides of the same seam. When a segment of this type is rejected it must be determined whether one or both operators were at fault, by subsequent tests of the individual operator's work."

11.05 (*c*) Revise (for the same reason as above) to read: "In joints subject to secondary stress: One segment shall be cut from approximately every 200 ft. of joint, except that if the full length of a circumferential seam is less than 200 ft., one segment shall be cut from each circumferential seam of cylindrical tank shells."

11.08 (*c*) Revise to read: "For butt joints, slag inclusion is permissible where it occurs between layers of the weld, is substantially parallel to the plate surface, and is equal to not more than one-half the width of the weld metal; and when it occurs across the thickness of the plant and is equal to not more than 10 per cent of the thickness of the thinner plate."

11.08 (*d*)–(*i*) Reletter these sub-sections to read sub-sections (*e*)–(*j*), respectively; then insert the following paragraph as sub-section 11.08 (*d*):

"(*d*) For lap joints, slag inclusion is permissible where it occurs between layers of the weld, is substantially parallel to the face of the weld, and is equal to not more than one-half the width of the weld metal, measured in a direction parallel to the face of the weld; and when its greatest dimension measured in a direction perpendicular to the face of the weld does not exceed 10 per cent of the throat."

12.02 Revise the first sentence to read: "After the bottom has been welded completely including the attachment of at least the first course shell sheet, ..."

Priorities and the Controlled Materials Plan

ON NOVEMBER 11, the Requirements Committee of the War Production Board authorized the application of the top priority rating of AA-1 to essential repairs and maintenance. Included in the scope of this determination, which becomes a basic policy for the first quarter of 1943, are essential repairs and maintenance for productive facilities, *utilities*, housing and consumers' durable goods.

Among other things, the action will assure water works of obtaining the materials required to keep them performing their essential functions; and under it, supplies and materials needed for essential maintenance and repair for housing may also be obtained.

Until the Controlled Materials Plan goes into full operation on July 1, 1943, the existing priorities system will be used to obtain the steel, copper and aluminum needed for such maintenance and repair. Under CMP, each agency will break down its material requirements in three ways—that needed for production, construction and facilities, and maintenance and repair. By including maintenance and repair requirements in the overall materials program, CMP provides a long-range assurance that the nation's essential industries and services will be kept in operation.

The general features of CMP were described in a release dated November 2, from the office of Donald M. Nelson, WPB Chairman. The text of this release follows.

Evolved from existing distribution systems and from experience gained through their operation, the CMP has the approval of all governmental agencies participating in it. It was drafted after lengthy conferences with the Army, Navy, Maritime Commission and Office of Civilian Supply as well as representative consumers and producers of materials who contributed many suggestions incorporated in the final version.

The main purpose of the plan is to make certain that production schedules are adjusted within material supply so that production requirements are met. This will be accomplished by adjusting requirements for critical materials to the supply and making the quantity and type of materials needed available at the time required to meet approved programs.

Allotments of critical materials will be made through seven "Claimant Agencies," such as Army, Navy, Office of Civilian Supply, etc., to prime contractors producing essential goods. Prime contractors, in turn, will divide the allotments with their subcontractors and suppliers.

Carbon- and alloy-steel, copper and aluminum—the three most basic and critical materials—are the first "Controlled Materials" to be directly allotted under the plan, which becomes effective, in its transitory stage, in the second quarter of 1943 and will be in full operation by July 1.

This method of distributing materials is, in effect, "vertical allotment." So far as Controlled Materials are concerned, it will gradually replace the present priority system, including the Production Requirements Plan, which is on a horizontal basis.*

Under PRP each firm, large or small, prime contractor or subcontractor, submits his own requirements to WPB for approval and receives an individual authorization to obtain materials.

Under the new CMP, prime contractors will prepare and submit a breakdown of all materials required for the approved end-products on which they are working. The breakdown will comprise a "Bill of Materials" specifying not only what materials are required, but when they must be received to carry out the authorized program.

In making up his Bill of Materials, each prime contractor will include both the materials he puts into production himself, and those needed by his subcontractors and their suppliers. The Bill of Materials will cover requirements not only for Controlled Materials, but also for other scarce materials listed in the outline of the plan.

The Bills of Materials obtained from prime contractors will be assembled by each Claimant Agency and submitted to the WPB Requirements Committee, and to the respective Controlled Materials Branches, which will make the necessary adjustments to bring the whole program into balance with available supplies.

The Claimant Agencies are: Army, Navy, Maritime Commission, the Aircraft Scheduling Unit, Lend-Lease, Board of Economic Warfare and Office of Civilian Supply.

The Aircraft Scheduling Unit, located at Wright Field, is the Claimant Agency for all aircraft production.

The Office of Civilian Supply, Claimant Agency for all producers not otherwise represented, will assemble its statement of requirements with the aid of recommendations by the various WPB industry branches.

* Although Priorities Regulation No. 10, establishing the Allocation Classification System was revoked on November 5, a memorandum accompanying the revocation order (see p. 1923) continued the requirement of end-use information on all orders for copper and copper-base alloys.

Each Claimant Agency will break down its submission of requirements into materials for: (1) production; (2) construction and facilities; (3) maintenance, repair and operating supplies. Requirements for construction and facilities, including industrial machinery and equipment, will be channeled through the Construction and Facilities Branch of the Office of Program Determination.

When requirements have been brought into balance with supply and the programs of the various Claimant Agencies are approved, the WPB Vice-chairman on Program Determination—who also is Chairman of the Requirements Committee—will allocate, with the advice of the Requirements Committee, authorized quantities of the three Controlled Materials to each.

The Claimant Agencies, in turn, will distribute these broad allotments among prime contractors by means of "Allotment Numbers," which will constitute a right to receive delivery. The prime contractors will pass on the Allotment Numbers, as necessary, to their subcontractors and suppliers.

Materials other than Controlled Materials will continue to be distributed through the priorities system. Each company receiving an Allotment Number carrying an allocation of Controlled Materials also will receive a preference rating for use in obtaining other materials. A preference rating accompanied by an Allotment Number will be higher than other ratings of the same category, but will not take precedence over higher ratings. For example, AA-3, plus an Allotment Number, is higher than AA-3, without the number, but not as high as AA-2X. The preference ratings also will resolve conflicts which might otherwise occur in the production and delivery of manufactured items.

In order that sufficient amounts of materials in the form desired may be available, responsibility for directing the production of Controlled Materials rests in the Controlled Materials Branches of WPB. For instance, the Iron and Steel Branch is responsible for steel, the Copper Branch for copper, etc. "Production Directives," specifying the quantities and forms and shapes of material to be produced during a stated period of time, will be sent to most producers of Controlled Materials monthly. If orders beyond a specified capacity to produce are received, a producer must refuse them and notify the appropriate Controlled Materials Branch. If a consumer with an Allotment Number cannot place his order satisfactorily, he should appeal to and will be assisted by the branch.

It was explained that the aim of the plan is to use every bit of critical material in the place where it will do the most good toward winning the war. Each governmental agency participating in the plan, therefore, is being required to present for approval programs which will lead to the maximum production of the things needed most from the materials available in any given period of time.

Each of these Claimant Agencies will be responsible for constructing a program making the best possible use of the materials allotted to it toward winning the war. At the same time, the plan provides centralized control over the division of materials among the agencies and appropriate accounting so that no agency nor contractor can overdraw its allotment.

As CMP goes into effect, the job of cutting out all non-essential production, military and otherwise, will be completed.

Under CMP, each Claimant Agency will program the quantities of end-products—guns, planes, Liberty ships, railroad cars, bedsprings, etc.—most urgently needed for each quarterly period. From the Bills of Materials for each of these items the agency will make up a consolidated estimate of its total requirements. These detailed estimates for the second quarter of 1943 must be submitted by January 1, 1943. At the same time, similar estimates must be submitted for the remaining quarters of 1943 and the first quarter of 1944, together with general estimates for the first half of 1944, so that the Requirements Committee will, at all times, have a general picture of requirements eighteen months in advance.

When the allotments are made by the Requirements Committee, they will be transmitted to prime contractors through the Claimant Agencies. Manufacturers working on items such as tanks, ships, aircraft, etc., which generally are contracted for by or through a Claimant Agency, and are called "Class A" products, will receive their allotment with an allotment number directly from the agency. Producers of a list of "Class B" products, such as generators, hardware, kitchenware, electrical appliances, parts frequently incorporated in other products, and civilian items generally, will receive their allotments from their WPB industry branches, which in turn will receive allotments through the Office of Civilian Supply.

Each Claimant Agency may allot for each month up to 105 per cent of its monthly allotment. This over-allotment is intended to stimulate increased production from producers of Controlled Materials. Claimant Agencies also are authorized to make allotments for future quarters on the basis of declining percentages of allotments established for the current quarter. These percentages are: for the quarter immediately following the one for which a definite allotment has been made, 80 per cent; for the next following quarter, 60 per cent; for all later quarters, 40 per cent.

The plan will be flexible enough to permit limited amounts of material to be given out without allotment numbers. Special provision, for instance, is made for allotments of Controlled Materials to warehouses so that they may handle small orders without Allotment Numbers.

A new form of inventory control is to be established with the requirement that every primary or secondary producer whose inventory of all Controlled Materials is in excess of a specified amount must submit an inventory

statement showing his position at the end of each calendar quarter not more than 15 days later.

A timetable for the transition from existing systems to full operation of the Controlled Materials Plan is provided. The first Bills of Materials, will be assembled by the Claimant Agencies during November and December and on January 1 the agencies will submit their first estimate of requirements to the branches handling Controlled Materials, with copies to the Requirements Committee.

By January 15 the Controlled Materials Branches will have analyzed the requirements and made preliminary reconciliation to the extent possible between requirements and supply. At the same time, the Claimant Agencies and prime consumers will be developing information necessary in making final allotments, to be in readiness for distribution of allotments to them by the Requirements Committee.

On February 1, the Requirements Committee will make allotments of Controlled Materials to Claimant Agencies for the second quarter of 1943. During February and early March, distribution of allotments will be made by Claimant Agencies to prime consumers, who in turn will divide their allotments with their secondary consumers and suppliers.

By March 15 users of Controlled Materials will have placed authorized orders for April delivery and for later months, as authorized. Subsequently, the Controlled Materials Branches will watch placement of orders on mills and mills' shipments, and give assistance in placing orders to authorized users of Controlled Materials who are unable to obtain mill acceptance of authorized orders.

On July 1, CMP will be in full operation. Until that time existing procedures, including preference rating orders and PRP certificates and individual material allocations under M orders will continue in effect for consumers who have not been able to qualify under CMP.

Those remote secondary consumers who have not obtained their allotments under CMP in time to meet requirements for the second quarter of 1943 will be authorized to continue purchases under PRP equal to their first quarter authorizations.

To prevent duplication, each company operating under PRP will be required to cancel authorizations made under PRP in equal amount for CMP allotments and the total authorizations outstanding at any time will not be permitted to exceed available supply. Orders bearing CMP Allotment Numbers will be given preference at mills over PRP orders and other rated orders not under CMP.

CMP will be supplemented by detailed regulations and instructions to be announced at a later date.

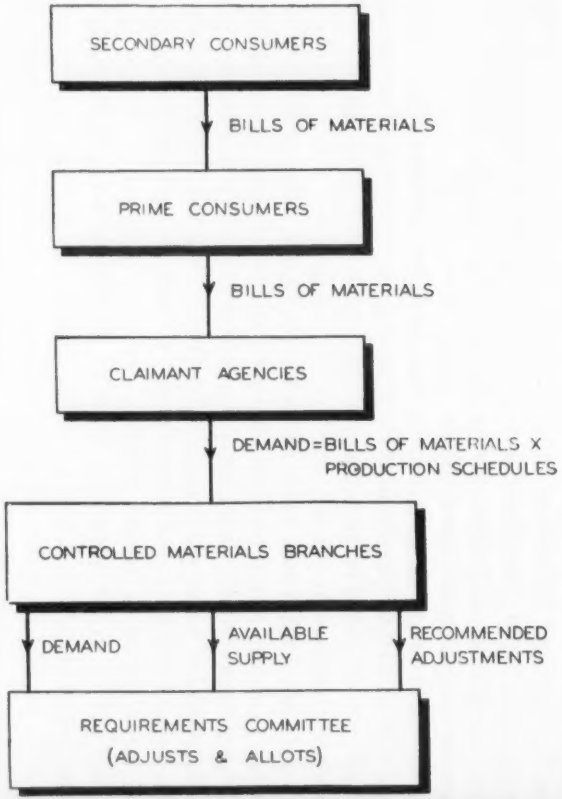


CHART A. Flow of Requirements for Demand

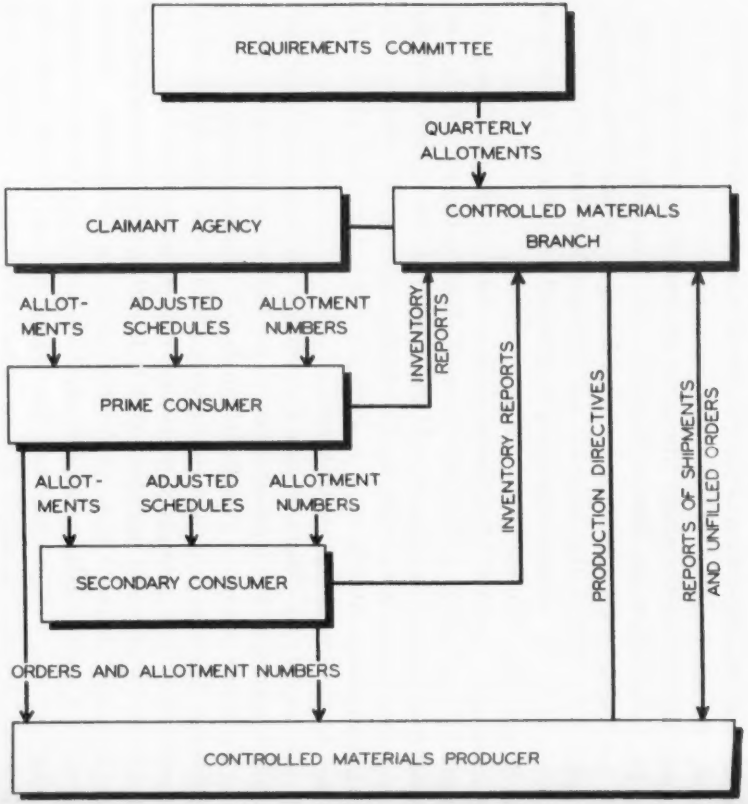


CHART B. Flow of Allotments for Supply

The flow of requirements for demand and the flow of allotments for supply under CMP are shown in the charts on page facing. Copies of the official pamphlet outlining the plan in detail are available from the regional offices of the WPB.

Revocation of Priorities Regulation No. 10

As a preliminary to the establishment of CMP Ernest Kanzler, WPB Director General for Operations, on November 5, issued an order which stated: "Priorities Regulation No. 10, establishing the Allocation Classification System, is hereby revoked." In a memorandum issued with the revocation order, however, the requirement of end-use information on all orders for copper and copper-base alloys was continued. To assure compliance with this exception, the Copper Branch then sent out the following letter:

WAR PRODUCTION BOARD
WASHINGTON, D.C.

November 11, 1942

To All Brass Mills, Wire Mills and Foundries:

Your attention is called to the Press Release T-1162 of November 6, 1942, which accompanied Mr. Kanzler's notice that Priorities Regulation No. 10, establishing the Allocation Classification System, has been revoked. This Press Release contains the following paragraph:

> "Although the Allocation Classification System is abolished by the action announced today, WPB's Copper Branch will continue to end-use information from brass mills, copper wire mills and copper foundries, before making allocations. To avoid delays in delivery, all persons ordering copper and copper-base alloy products from mills and foundries are warned that they must provide as much end-use information as possible, in order that the suppliers may include it in their applications for WPB authority to fill particular orders."

Accordingly, as we shall look to you to continue to furnish us with the end-use information you have supplied us in the past, it is suggested that you send copies of this letter to your customers so that they will understand the necessity of continuing to supply you with such information.

Very truly yours,
(signed)
H. O. KING
Chief, Copper Branch

CHART A. Flow of Requirements for Demand

CHART B. Flow of Allotments for Supply

OFFICE OF PRICE ADMINISTRATION
WASHINGTON, D. C.

Temporary Building D

In Reply refer to: 734:RGL

NOV 28 1942

American Water Works Association
22 East 40th Street
New York, New York

Attention: Harry E. Jordan, Secretary

Gentlemen:

This will acknowledge your letter of November 18, 1942, concerning the provisions of the Tire Rationing Regulations for vehicles used to maintain public water supply service.

Section 405 (f) (2) of the Tire Rationing Regulations (Revised) provides that a truck is eligible for new tires or tubes or recapped tires when used exclusively for the transportation of material and equipment for construction or for mechanical, structural or highway maintenance or repair.

The repair service mentioned in this paragraph is not limited to highway repairs but would include the repairs necessary for the maintenance of water supply systems.

Section 504 (a) (2) of the Tire Rationing Regulations (Revised) provides that a passenger car is eligible for recapped tires or recapping service when used principally for the transportation of persons to enable them to render construction or mechanical, structural or highway maintenance and repair services.

This Section makes provision for the transportation of workers to enable them to render necessary maintenance services to water supply systems.

This, we believe, gives you the information requested.

Very truly yours,

Robert S. Betten

Robert S. Betten
Chief
Tire Rationing Branch

NATIONAL WAR LABOR BOARD
DEPARTMENT OF LABOR BUILDING
WASHINGTON, D. C.

December 1, 1942

Mr. Harry E. Jordan, Secretary
American Water Works Association
22 East 40th Street
New York, N. Y.

Dear Mr. Jordan:

I have your letter of November 23rd, inquiring about the nature and form of the certificate that must be filed with the Joint Committee on Salaries and Wages by States and political subdivisions of States. The Joint Committee has not prescribed a form upon which this certification is to be made. For the present, and until such time as a form is prescribed, States or political subdivisions of States who wish to secure approval of salary or wage adjustments should certify, in such form as they deem most appropriate, to the Joint Committee, facts that it or they think sufficient to sustain the propriety of the adjustment requested.

We enclose herewith a copy of General Order No. 9 of the Board and a copy of a Joint Statement of the National War Labor Board and the Commissioner of Internal Revenue on the Procedure for Wage and Salary Adjustments by State Governments and Subdivisions and Agencies thereof.

Very truly yours,

Jesse Freidin
Assistant General Counsel

(Water works executives should write the National War Labor Board at the above address for copies of the order and statement cited.)

LOUIS D. BLUM & CO
Certified Public Accountants
110 East 42nd Street - New York

October 10, 1942

American Water Works Association
22 East 40th Street
New York, N. Y.

Gentlemen:

Pursuant to your instructions, we have made an examination of your records for the purpose of verifying the number of copies of the Journal of the American Water Works Association, Volume 34, No. 9, September 1942, publicly distributed during the month of September 1942 and, as a result of such examination, submit the following information:

Paid Circulation		
Water works superintendents, engineers, specialists, municipal water departments, etc. (Members)	3,893	
Manufacturers of water works supplies and equipment (Members)	215	
Colleges and libraries (Domestic)	240	
Colleges and libraries (Foreign)	152	
Single copies:		
Miscellaneous	1	
Total Paid Circulation		4,501
Free Copies		
Exchange (Domestic)	28	
Exchange (Foreign)	15	
Advertisers and advertising agencies	140	
Membership promotion	90	
Authors	19	
Miscellaneous	3	
Total Free Copies		295
Total Circulation		*4,796

*30 applicants for membership, whose applications were filed during the month of September 1942, will receive copies of the September Journal in the succeeding month when their applications are approved and the applicants are admitted as members.

In our opinion, the foregoing is a correct statement of the circulation of the aforesaid publication during the month of September 1942.

Very truly yours,

Louis D. Blum & Co.
Certified Public Accountants

The 1942 Conference

CHICAGO, host to the American Water Works Association in 1890, 1902, 1927 and 1933, was again the gathering point for water works men from June 21 through June 25, 1942, as they considered "Wartime Water Works Problems" in the sixty-second annual meeting of the A.W.W.A. The Stevens Hotel was adequate for all exhibits, technical sessions and social events. It was fortunate that the meeting was scheduled for June, for only a few weeks later the Stevens Hotel was taken over by the Army Air Corps as a training center.

The attendance at A.W.W.A. conventions, since the pay-as-you-register plan went into effect has been as follows:

Year	*City*	*Total Registered*	*Year*	*City*	*Total Registered*
1929	Toronto	1,104	1936	Los Angeles	891
1930	St. Louis	1,021	1937	Buffalo	1140
1931	Pittsburgh	1,076	1938	New Orleans	1123
1932	Memphis	712	1939	Atlantic City	1290
1933	Chicago	660	1940	Kansas City	1467
1934	New York City	891	1941	Toronto	1445
1935	Cincinnati	901	1942	Chicago	1438

The Convention Management Committee consisted of:

Representing A.W.W.A.

Wm. J. Orchard, *Chairman*
Reeves Newsom
W. W. DeBerard

Representing W. & S.W.M.A.

Clinton Inglee
Arthur T. Clark

Ex-Officio

Louis R. Howson
Linn H. Enslow
Denis F. O'Brien
John A. Kienle
Harry E. Jordan

Illinois Section. Officers and members of the Illinois Section gave every bit of co-operation in planning and operating the meeting that could have been desired. The value of local organization and interest in the conferences of the A.W.W.A. cannot be overstressed. While the Convention Management Committee and the Association's officers, as a result of experience with many meetings, know what pitfalls must be avoided and how closely the expenditures of funds must be controlled, the enthusiasm of the local and regional groups must be put to useful work in order to have an entirely successful convention.

The Illinois Section Committees were:

Local Convention Committee:	W. W. DeBerard, *Chairman*
	H. H. Gerstein, *Vice-Chairman*
	Chas. B. Burdick
	Paul Hansen
	John P. Harris
	F. W. Hartmann
	H. E. Hudson Jr.
	George B. Prindle
Local Host Committee:	John P. Harris, *Chairman*
	H. E. Babbitt, *Vice-Chairman*
Local Transportation Committee:	James Judge, *Chairman*
	H. L. Meites, *Vice-Chairman*
Water Works Get-Together:	Mr. & Mrs. George B. Prindle, *Chairmen*
	Mr. Chas. B. Burdick & Miss Janet Burdick, *Vice-Chairmen*
President's Reception and Dance:	Mr. & Mrs. H. H. Gerstein, *Chairmen*
	Mr. & Mrs. L. I. Birdsall, *Vice-Chairmen*
Water Wardens' Night:	A. E. Gorman, *Chairman*
	O. T. Birkeness, *Vice-Chairman*
Dinner-Dance:	Mr. & Mrs. L. D. Gayton, *Chairmen*
	Mr. & Mrs. F. W. Hartmann, *Vice-Chairmen*
Ladies' Rendezvous Committee:	Mrs. F. W. Hartmann, *Chairman*
Ladies' Luncheon and Fashion Show:	Mrs. W. W. DeBerard, *Chairman*
Ladies' Luncheon Bridge:	Mrs. A. E. Gorman, *Chairman*

Attendance Promotion. Under the leadership of Joseph M. Wafer, the 1942 Conference promotion was more adequate than in the case of any previous meeting. Mr. Wafer's report in part stated:

"The trade papers *American City*, *Engineering-News Record*, *Public Works*, *Southwest Water Works Journal*, *Water Works and Sewerage* and *Water Works Engineering* were very helpful in the donation of space, editorial matter and news items publicizing the intent of the meeting. Their efforts are a very valuable contribution to the promotion of this annual conference.

"House organs such as those put out by U.S. Pipe & Foundry Co., R. W. Sparling Co. and the Industrial Chemical Sales Division of the West Virginia Pulp and Paper Co. were used to advantage. Many of the manufacturers boxed their ads in accordance with the suggestion offered.

"Through the Chairman's association with the Industrial Chemical Sales Division, a greater effort was made this year by this company as its contribution toward promoting attendance; and the June issue of its publication, *Taste & Odor Control*, was particularly geared to this purpose.

"The committee is indebted to Hector P. Boncher, Sales Mgr., Dresser Mfg. Co., Bradford, Pa., for suggestions on the promotion of this meeting, many of which were used by the Secretary of the American Water Works Association.

"The Illinois Section was very active in mailing out various promotional pieces all with the thought of promoting attendance at the Conference and a great effort was made by them to bring out the Illinois Section to this meeting.

"More than 4,000 timetables, containing a promotional message, were mailed to the membership of the American Water Works Association by the Pennsylvania Railroad and this, of course, acted as a further reminder of the Conference.

"Approximately 5,000 pencils were distributed, some through the Attendance Promotion Committee through their personal contacts, some through the secretaries of the various Sections holding their meetings prior to the Conference.

"Some 30,000 stickers were furnished to the members of the Water and Sewage Works Manufacturers Association to be included on any mail or promotional pieces going to the water works personnel."

The Secretary of the A.W.W.A. sent to all members a preliminary announcement of the dates and place of the meeting on September 19, 1941, and mailed out a hotel reservation card early in December 1941. Early in April 1942, a special announcement of the meeting, an announcement of special service by the Pennsylvania Railroad, and another hotel reservation card went to all members and to all water works superintendents in the States of Minnesota, Wisconsin, Iowa, Illinois, Nebraska, Kansas, Missouri, Indiana, Ohio and Michigan. On June 9, 1942, all members, as well as the same group of superintendents, received

an eight-page preliminary program, designed under the direction of Hector P. Boncher.

Attendance. The recorded paid attendance at the Chicago Conference was very little lower than that at Toronto and Kansas City. If complimentary registrations granted to members of the Chicago City Engineering staff were included, the total registration would be above the Kansas City record. The simple fact is that in 1942 the Chicago Conference on Wartime Water Works Problems brought together as many active and interested public servants as any meeting the Association has ever sponsored. The technical sessions were very well attended, with the Thursday morning session, addressed by J. A. Krug, Chief of the Power Branch of the War Production Board, bringing together nearly 700 attentive listeners. No session in recent years has commanded so much attention—and been of such value to water works men.

Convention Program. The decision to key the conference about wartime problems was definitely worth while. The addresses covered topics of current interest and were related to the new problems facing water works. The Publication Committee under Chairman Enslow again demonstrated its value to the Association.

Exhibits. The Stevens Hotel exhibit hall was ample for the material that had been prepared by the manufacturers. Under the management of Arthur T. Clark, exhibit arrangements were well planned. Late on each afternoon of the conference, motion pictures of water works interest were shown in the exhibit hall. It can be anticipated that this will be a regular feature of the A.W.W.A. conferences hereafter.

Entertainment. Clinton Inglee was again in charge of entertainment and maintained it upon the high level that has grown to be a part of A.W.W.A. meetings. Mrs. Paul Hansen graciously directed the entertainment that was provided for the ladies. For the first time, a professional hostess was employed to handle the many details that, while time-consuming, contribute materially to the enjoyment of the ladies who attend A.W.W.A. meetings. The evening entertainment omitted the All-Section dinner. A "Water Warden's Night" afforded amusement on Tuesday evening. On Wednesday, the annual dinner-dance closed the conference social events.

Inspection Trips. The Chicago Transportation Committee arranged for inspection trips to points of water works interest, including the South District Filtration Plant. Naturally, wartime conditions limited trips of this character to persons of known loyalty.

Presentation of Awards

Honorary Membership was conferred upon Messrs. James M. Caird, Wilfred W. DeBerard and William E. Vest. The citations were:

James M. Caird, a consulting chemist and bacteriologist of Troy, N.Y., a member of the Association since 1900; its Treasurer 1914 to 1921. A pioneer in the purification of public water supplies who contributed much to the attainment of present high standards of quality.

Wilfred W. DeBerard, City Engineer of Chicago, a member of the Association since 1912; Past Chairman of the Illinois Section; for thirty years an active participant in the affairs of the local sections and the general Association and contributing markedly to their success. Member of the Water Works Practice and Publication Committees.

William E. Vest, Manager of the Charlotte, N.C., water works; a member of the Association since 1911; Director, 1931; Past Chairman, charter member and active in the affairs of the North Carolina Section; has rendered outstanding service to his community and been an inspiration toward better water works operation.

The John M. Diven Medal, annually awarded to the member whose services to the Association are deemed most outstanding, was presented to Samuel F. Newkirk Jr., with the following citation:

Samuel F. Newkirk Jr., for his leadership of the Committee on Meters during the past two years. The completed report made by the committee, covering Cold Water Meters—Displacement Type, as published in the December 1941 JOURNAL, is of substantial value to the entire water works field.

The John M. Goodell Award, for the best paper published in the JOURNAL of the Association, was presented to:

R. F. Goudey, for his paper in the March 1941 issue of the JOURNAL entitled "Practical Aspects of Cross-Connection, Inter-Connection and Back-Flow Protection." In this paper the author discusses a matter of grave concern to everyone responsible for the delivery of a safe and potable water to the consumer. The material is very complete, well organized and carefully analyzed, and the recommendations are excellent. The great value of the information and recommendations for the record completely justified the immense amount of labor necessary for the preparation of the paper.

George W. Fuller Memorial Award certificates were presented to the following members:

California Section—*Charles Gilman Hyde:* In recognition of his inspiring leadership as a teacher for many years in the University of California; for his encouragement and training of men in the field of public sanitation; for his contributions to water treatment practices; and for his outstanding contributions to the organization and success of the California Section.

Canadian Section—*Robert William Angus:* For his noteworthy contributions to research in water hammer and other hydraulic subjects, and for his leadership qualities in his work as Professor of Mechanical Engineering in the University of Toronto.

Florida Section—*William Benjamin Gibson:* For his keen interest in Section activities and his leadership in the organization of the Florida Water Works Operators Association.

Four States Section—*Carl John Lauter:* For his outstanding contributions to the field of bacteriology and filter plant operation, and for his service to the Four States Section and the Association.

Illinois Section—*Herbert Edson Hudson Jr.:* For his outstanding service as Secretary of the Illinois Section and his constructive leadership in the expansion of its membership.

Indiana Section—*Blucher Adams Poole:* In recognition of his conspicuously competent and extraordinarily unselfish service to the water works profession, particularly during the crucial year just past, and for his inspiring example to water works men in the State of Indiana.

Kentucky-Tennessee Section—*Robert Paul Farrell:* In recognition of his outstanding work in developing and establishing a rating and approval system for water works in Tennessee; and for his activity in connection with the program for the certification of water plant operators.

Michigan Section—*Douglas Feben* and *Roberts Hulbert:* For their original and painstaking studies on the accuracy of odor determinations.

Minnesota Section—*Ronald M. Finch:* For long and effective service and devotion to the Minnesota Section—far beyond the ordinary obligations of his office.

Missouri Valley Section—*William Theodore Bailey:* In recognition of his outstanding work in the operation of the Council Bluffs Water Treatment Plant; his contributions to the field of water purification; and his participation in community activities.

Montana Section—*Herbert Branch Foote:* In recognition of his fine character, personality and ability; his long and progressive leadership of the Montana Section and the Montana School for Water Works Operators; and his valuable contributions to the advancement of water works practice.

New Jersey Section—*Joseph Arthur Carr:* As a tribute to his long and faithful service to the Ridgewood, N.J., Water Department; his engineering skill, and successful management of its properties and public relations; his services to the New Jersey Section and the Association.

New York Section—*Rollo Kimball Blanchard:* In recognition of his long and unselfish service which contributed so much to the growth and progress of the New York Section.

North Carolina Section—*William Christian Olsen:* In recognition of his engineering skill and achievements; his contributions to the development and progress of the North Carolina Section.

Ohio Section—1942—*Hayes Robinson Kuhns:* In recognition of his untiring efforts in promoting the interest of the Association and for his devoted and sustained efforts in behalf of the Ohio Section.

Ohio Section—1940*—*Thomas Ridgway Lathrop:* For his services in connection with the development of the Ohio Section and the Ohio Conference on Water Purification.

Pacific Northwest Section—*Milton Hunt McGuire:* In recognition of his distinguished services to the water works profession; his contributions to the advancement of the community in which he lives; his devotion to the interests of the Pacific Northwest Section and the Association.

Rocky Mountain Section—*Oliver Jesse Ripple:* In recognition of his outstanding work in the field of water purification; his contributions to the Water Works School; and his noteworthy services as Director for the Section.

Southeastern Section—*William Davis Moore:* For his outstanding efforts in the interests of, and valuable contributions to the knowledge and advancement of the water supply industry; and his co-operative interest in the activities of the Association.

Southwest Section—*Edward Ray Stapley:* In recognition of his services to the water supply schools in Oklahoma and Arkansas during the past several years.

Virginia Section—*Dayton Rice Taylor:* In recognition of his splendid public relations work and inspirational talks on the subject; for his valuable contributions to water works operation through his studies of metering practices; and for his untiring service to the Virginia Section.

* This award was made at the 1940 Ohio Section Meeting which was held subsequent to the 1940 Convention of the Association and the listing was omitted from the 1941 list of citations.

West Virginia Section—*Thomas Lee Young:* For his long-term activities in the water works profession; and for his leadership and generous contributions of time and services to the advancement of the West Virginia Conference on Water Purification and the West Virginia Section.

Western Pennsylvania Section—*James Smith Dunwoody:*† In recognition of his long and faithful service to the Association; and for his efficient organization and operation of the Water Department of Erie, Pa.

Wisconsin Section—*Walter Anderson Peirce:* For his conspicuous and inspirational work in the reconstruction and management of the Racine Water Utility; and for his devotion to, and advancement of the interests of the Wisconsin Section.

No Fuller Memorial Awards were made by the Cuban and New England Sections during the last Association year.

The Nicholas S. Hill Cup, awarded annually to the Section having the greatest percentage gain in membership from one general meeting to the next, was won by the Illinois Section. Its point score was 42.042. Second and third, respectively, were the Virginia Section (point score 30.784) and the Wisconsin Section (point score 21.488).

The Henshaw Cup, awarded annually to the Section having present at its annual meeting the greatest percentage of its membership, was won by the Minnesota Section. At its 1941 meeting, 82.56 per cent of its membership attended. Second and third, respectively, were the Montana Section (76.19 per cent) and the North Carolina Section (63.72).

The Old Oaken Bucket remains in the possession of the California Section. This conference was the fourth at which the award for top Section membership has been made, and the fourth time that the California Section (546 members) received the award.

Schedule of Papers and Reports

General Session—9:30 A.M.—June 22, 1942

Administrative Problems of Water Works in Wartime.....
H. H. Brown, L. A. Geupel, K. K. King
L. G. Lenhardt, H. S. Morse
The War and Water Rates.....Reeves Newsom

Water Purification Division—9:30 A.M.—June 22, 1942

The Manipulation and Identification of Micro-organisms.....James B. Lackey
Control of Micro-organisms.....L. F. Warrick, F. J. McKee, W. Van Horn
Traveling Laboratory Control of Bottlers Operation.....Bert Wells
Specifications for Filtering Material—Committee Report.....
Paul Hansen, *Chairman*

† Deceased March 21, 1942.

General Session—2:00 P.M.—June 22, 1942

Introduction to Chicago's Problems.....W. W. DeBerard
Conservation of Critical Materials in Filter Plant Design.....F. G. Gordon
Chemical Treatment and Equipment for Chicago's South District Filtration Plant
Paul Hansen, J. R. Baylis
Civilian Defense Protection of Chicago's Water Supply.....Arthur E. Gorman
Maintaining Efficiency of Equipment in Chicago's Pumping Stations.....
Frank J. McDonough, Paul Lippert, Julian M. Veggeberg

General Session—9:30 A.M.—June 23, 1942

Guarding Water Works Property.....
Warren J. Scott, Harry U. Fuller, W. W. Hurlbut
Effects of Air Attack Upon Utility and Other Structures.....Walter D. Binger
The Mutual Aid System at Work.....
Howard H. Potter, John J. Murdoch Jr.,
Earl Devendorf, Clarence W. Klassen
The Importance of Water Supply in Civilian Defense.....Ralph E. Tarbett

Plant Management & Operation Division—2:00 P.M.—June 23, 1942

Good Practice in Water Works Management.....Wendell R. LaDue
Choosing a Water Works Superintendent.....Dale L. Maffitt
Organization and Equipment for Emergency Repair of Distribution Systems.....
W. Victor Weir
Discussion.....Bernard W. Cullen
Metallizing as a Method of Water Works Maintenance.....C. E. Palmer

Water Purification Division—2:00 P.M.—June 23, 1942

Methods for Determination of Residual Chlorine (Committee Progress Report).....
C. K. Calvert, *Chairman*
Chlorine Residual and Bacteriological Quality.....
Max Levine, Austin Heller, Richard Bender
Maintenance of Chlorine Residual in the Distribution System.....
Clyde R. Harvill, J. H. Morgan,
Major C. Hagar, A. R. Todd

Plant Management & Operation and Finance & Accounting Divisions—9:30 A.M.—June 24, 1942

The Omaha Water Works—A Successful Business.....Walter S. Byrne
The Jonesboro Water Works—A Successful Business.....Lloyd M. Rebsamen
Survival and Retirement Experience With Water Works Facilities (Committee Progress Report).....E. H. Aldrich, *Supervising Co-ordinator*
Round Table Discussion—Current Supply Problems.....
W. W. DeBerard, Eugene Dugger, G. L. Fugate,
Marsden C. Smith, T. T. Quigley

Water Purification Division—9:30 A.M.—June 24, 1942

Conditioning Methods to Inhibit Corrosion (Committee Report).....
E. W. Moore, *Chairman*
Critical Problems in the Boiler Feed Water Field.....M. C. Schwartz
Effect of Water Conditioning on Locomotive Maintenance.....Clarence Knowles
Stabilization of Lime-Soda Softened Water.....Charles P. Hoover
Discussions.....Daniel H. Rupp, Owen Rice

General Session—2:00 P.M.—June 24, 1942

Ground Water—A Vital National Resource:
- General Nature of the Current Problems.....O. E. Meinzer
- Midwest Problems.....Charles B. Burdick
- Southeastern Problems.....Malcolm Pirnie
- Long Island Problems.....Kyle Forrest
- Pacific Coast Problems.....Samuel B. Morris

Promoting Conservation of Water by Rate Surcharges.....Frank C. Amsbary Jr.
- Discussion.....J. J. Doland

Steel Pipe Committee—Open Session—2:00 P.M.—June 24, 1942

Opening Remarks.....W. W. Hurlbut
The Design of Ring Flanges for Steel Water Pipe.....H. O. Hill
Steel Siphon Rehabilitation on the Los Angeles Aqueduct.....
W. W. Hurlbut, Burton S. Grant, H. Arthur Price
Acceptance and Use of A.W.W.A. Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe.....
Deming Bronson, George B. McComb
Report of War Production Board Technical Advisory Committee on National Emergency Steel Specifications for Steel Water Pipe.....R. E. Barnard

Finance & Accounting Division—9:30 A.M.—June 25, 1942

Studies of Consumers' Demand for Water.....A. P. Kuranz
Survey of Billing and Collection Practices of Cities of 100,000–200,000 Population
George F. Hughes
Water Bills as a Lien Against Property Served.....H. L. Meites
The Accounting Manual's Balance Sheet.....Charles E. Moore
- Discussion.....M. F. Hoffman

Plant Management & Operation Division—9:30 A.M.—June 25, 1942

Planning and Operating Storage in Distribution Systems.....J. P. Schwada
Good and Bad Practices in Maintenance of Elevated Tanks.....Walker B. Davis
Method of Handling Street Excavations.....D. D. Gross
The Use of Compressed Air in Maintenance Work.....LaVerne Trentlage

Papers Scheduled at Section Meetings

THERE follows a summary-listing of papers scheduled for presentation at Section meetings during 1942. The locations and dates of the 1942 Section meetings are given on page 1944. A record of membership totals at the time of, and attendance at, the meetings in 1938–42 is presented on page 1945. Section officers who were elected at meetings held during 1942 and who will be holding office on January 1, 1943 are listed on page iv of this JOURNAL.

California Section—Scheduled Papers

Priorities and Current Water Works Problems ..... Harry E. Jordan
Address of Welcome ..... *Mayor* John F. Slavich
Water Works in Wartime ..... Frank V. Ragsdale
War Problems of the East Bay Municipal Utility District ..... John S. Longwell
Common Sense Attitude in Guarding ..... George A. Hunt
Proposed Changes in Treasury Department's Drinking Water Standards ..... R. F. Goudey
Adjudication of Water Rights of the Raymond Underground Basin ..... C. W. Sopp
Use of Metallic Sprays in Water System Maintenance ..... J. S. Stevens
Chemical Warfare and the Water Works Field ..... J. F. Smith
Discussion ..... H. A. Van Norman
War Emphasis in Water Works Management ..... Samuel B. Morris
Safeguarding Surface Water Supplies ..... *A Motion Picture*
Substitute Materials in the Water Works Industry ..... Richard Bennett
Wartime Sanitation as Affecting Water Works Operations ..... R. E. Tarbett
Consideration in Camouflage Methods Selected for the Protection of Los Angeles Aqueduct and Distribution System ..... Sterling Green
Lazy Man's Water Works ..... George L. Woods
Recommended Practice for Emergency Repairs to Water Systems ..... George W. Pracy
San Diego's Water and Sewage Problem ..... F. A. Rhodes
Organization and Activities of the Subcommittee on Water Supply, California State Council of Defense ..... Charles Gilman Hyde, Harry Reinhardt and Murray R. MacKall
Sanitary Hazards From Inter-System Connections and Auxiliary Supplies ..... E. A. Reinke
Pollution of Water by Chemical Warfare Agents and Their Detection ..... John Doble, Frank M. Goyan, H. C. Medbery and W. J. O'Connell Jr.
Chlorine Residual and Bacteriological Quality ..... Max Levine
Water Sanitation With Silver ..... Alexander Goetz

Canadian Section—Scheduled Papers

Address of Welcome ..... *Mayor* G. R. Inglis
Address ..... Louis R. Howson
The Future of Water Chlorination ..... Harry A. Faber
Influence of Plant Design and Construction Upon Filtration Problems, Illustrated by Special Reference to Buffalo, N.Y. ..... Henry F. Wagner
Guided Discussion—Reservoirs and Water Tanks ..... *Led by* W. L. McFaul
Wartime Supply Problems ..... M. J. McHenry
Guided Discussions:
Maintenance of Deep Wells and Their Equipment ..... *Led by* E. V. Buchanan
Recent Increased Water Consumption and How to Meet This Abnormal Demand .... *Led by* R. L. Dobbin
Maintenance of Filter Beds and Control Equipment ..... *Led by* O. H. Scott
Modern Trends in Pumping Station Equipment ..... Norman G. MacDonald
Guided Discussion—Miscellaneous Wartime Water Works Problems ..... *Led by* William Storrie

Cuban Section—Scheduled Papers

Address of Welcome ..... Jose Garcia Montes
Address of the President of the IV National Engineering Congress
Address ..... Enrique Montoulieu
Protection of Aqueducts as a Measure of Civilian Defense ..... Gustavo A. Becquer
Chlorine and Its Salts and Their Microbic Applications to Waters in Cuba—Techno-economical Study ..... Antonio Valles
Project of the Aliviadero Canal in the Agabama Pool (Shed) .... Rafael Sanchez Giquel
Cement Exposed to Aggressive Agents ..... Miguel Villa
Water-Taxation in the Cuban Aqueducts ..... J. A. Cosculluela

Florida Section—Scheduled Papers

Address of Welcome ..... *Mayor* C. H. Reeder
Greetings From the Department of Water & Sewers ..... W. A. Glass
Response and Report of Section Activities ..... W. B. Gibson
Maintenance of Public Water Supplies for Civilian Defense ..... D. W. Evans
Organization and Training of Auxiliary Repair Crews ..... F. A. Eidsness
The Importance of Water Resources to the War Effort ..... George E. Ferguson
Water and Sewerage Installations at Army Bases in Florida ..... T. B. Jenson
War Activities of the Bureau of Sanitary Engineering in the Water Works Field .... J. B. Miller
New Developments and Observations in the Water Works Field .... Fred E. Stuart
Reconditioning Filters and Equipment at the Atlanta Filtration Plant ..... C. I. Loudenbeck
How Water Works Operators May Be Trained Under the ESMWT Program .... N. C. Ebaugh
An Introduction to Ozone Treatment of Water ..... Victor Hann
Construction and Operation of the Miami Experimental Pilot Plant ... A. B. DeWolf
The Place of Public Water Supply in the War Effort ..... Abel Wolman
Well Construction Problems and Methods ..... Sidney A. Stubbs
Ground Water Investigations in Florida ..... H. H. Cooper Jr.
Passive Defense of Water Works Plants and Pumping Stations ..... J. Warren Armistead Jr.
Recent Developments in the Stabilization of Water ..... James T. Potter
Color Removal With the Accelator ..... J. M. Kahn

Four States and New Jersey Sections—Joint Meeting—Scheduled Papers

Round Table Discussion—Water Conservation
James H. Allen, R. C. Beckett, H. T. Critchlow, R. I. Dodd
M. J. McLaughlin and G. J. Requardt
Reduction of Excess Inventory Through Mutual Aid Plans.... John H. Murdoch Jr.
Water Works and the War Production Board.....Arthur E. Gorman
Round Table Discussion—Priorities
Address.....Wm. W. Brush
Address.....Harry E. Jordan
Address.....Reeves Newsom
Advantages of Attendance at A.W.W.A.....*A Motion Picture*
Flood Emergency Experiences.....B. S. Bush and M. J. Barrick
Discussion.....Myles Edwards and George Taylor
High Residual Testing.....A. E. Griffin and N. S. Chamberlin

Indiana Section—Scheduled Papers

Address of Welcome.....Edward C. Elliott
The Water Plant Superintendent and the Accountant.....Otto C. Jensen
What Can the Water Plant Superintendent Do?.....B. A. Poole and Paul Reed
Trends in Personnel Today.....Esther Rains
Maintaining Good Water Service in Times of Emergency.....Harry E. Jordan
Join the A.W.W.A.....*A Motion Picture*
Progress Report of the Indiana Section Technical Committee.....F. A. Schaefer
Lessons From the Long Extended Drought.....Hugh A. Barnhart
Importance of Accident Prevention.....Ralph J. Young
Repairing for Defense.....Louis R. Howson
Fire Protection and Prevention.....*Conducted by State Fire Marshal's Department*
Efficient Fire Protection and Prevention in Times of National Emergency....
Robert Hamm
Arson and Sabotage.....Gordon Sherer
Emergency War Repairs for Public Water Supplies.....David B. Johnson
Utility Operation During This Emergency.....Frederick F. Eickhorn
Training for Service.....A. A. Potter
Emergency Precautionary Measures.....M. H. Schwartz

Kentucky-Tennessee Section—Scheduled Papers

Address of Welcome.....*Mayor* Pierce E. Lackey
Address of Welcome.....Roy M. Shelbourne
Response.....R. R. Harris
Along the Water Front.....Harry E. Jordan
Can American Water Systems Provide for Civilian Defense?.....J. R. Snyder
A Plea to Water Works for Scrap Materials.....R. D. Sheldon
Chicago Conference of A.W.W.A. (*A Motion Picture*).....John P. Harris
Cleaning Filters With Sulfur Dioxide.....H. B. Channon
The Effect of Water Waste on Power Consumption.....H. E. Beckwith
The Water Works Mutual Aid Program in Indiana.....Louis A. Geupel
Discussion—Application of Mutual Aid Program to Kentucky and Tennessee
The Paducah Water Works.....Louis R. Howson
Water Main Cleaning in the War Effort.....Clinton Inglee
Keeping Water Mains Clean With Calgon.....F. T. Redman
Round Table Discussions—Wartime Emergency Problems:
The New Wartime Alum
Iron Salts as Substitutes for Filter Alum
Non-Critical Service Materials
How Can We Obtain Plant Maintenance Materials?
Water Works Inventories and Surplus Materials According to W.P.B. Rulings

Minnesota Section—Scheduled Papers

Opening of Conference ..... W. P. Tarbell
Tires for Water Supply Equipment ..... Wright W. Brooks
Synthetic for America's Independence ..... W. G. Kearney
"Keep 'Em Rolling" ..... *A Motion Picture*
Rationing Water Works Materials ..... Lee Jensen
Panel Discussion—Problem of Operation of Water Works With Substitute Materials ...
Led by L. N. Thompson, A. M. Kircher and A. C. Wallace
Care and Maintenance of Elevated Steel Tanks ..... N. W. Viebahn and J. C. Bang
Water Supply in the Civilian Defense Program ..... Wm. H. Cary Jr.
Defense of Water Supplies Against Sabotage ..... O. E. Brownell
Emergency Repairs for Water Supplies ..... Jack F. Whalen
Safety Appliances in Water Plants ..... V. W. Buys
Address ..... Abel Wolman
Taste and Odor Control ..... Wm. D. Hurst
Progress Report on Water Softening at Minneapolis ..... Frank Raab
Water Softening Problems at the Twin City Ordnance Plant ..... Howard J. Sowden
River Pollution Above the Twin City Intakes ..... J. Arthur Jensen

Missouri Valley Section—Scheduled Papers

Address of Welcome ..... *Mayor* William Dee Becker
Panel Discussion—Increasing the Life of Equipment and Materials Used by Water Works Plants ..... *Led by* W. Victor Weir
The Civilian Defense Program ..... H. D. McBride
Water Supplies and the Civilian Defense ..... Ralph E. Tarbett
Panel Discussion—Water Works Labor Problems Under War Conditions .....
Led by Vance C. Lischer
Round Table Discussion—What Have You Done to Prepare Your Water System for Civilian Defense?
The Place of the Public Water Supply in War Effort ..... Abel Wolman
Panel Discussion—Adjustments in Operating Procedures Brought About by Rubber Restrictions ..... *Led by* Melvin P. Hatcher
A Priorities Clinic ..... *Conducted by* A. P. Ideson

Montana Section—Scheduled Papers

Address of Welcome ..... *Mayor* J. J. Haytin
Address ..... *Governor* S. C. Ford
Procurement of Essential Water Works Materials ..... Harry E. Jordan
Address ..... W. F. Cogswell
Chairman's Address ..... H. B. Foote
Program of the Public Works Reserve ..... Martin Kelly
Sabotage of Public Utilities ..... Kenneth Logan
Priorities Today ..... Oscar A. Baarson
Importance of Water Supply in National Defense ..... G. E. Arnold
Highlights of Stream Flow in Montana ..... A. H. Tuttle
Water ..... Fred Buck
Round Table Discussion ..... *Led by* C. W. Eyer
Description of the Helena Water Works ..... A. K. Richardson

New Jersey Section—Scheduled Papers—Spring Meeting

(*For fall meeting program, see Four States and New Jersey Sections Joint Meeting*)

Work of the New Jersey State Defense Council With Relation to Utilities .....
Thomas Dignan
Water Works Co-operation for War ..... John H. Murdoch Jr.

The Water Works Superintendent and the War.....John H. Brewster
War Materials and Water Works Service.....Harry E. Jordan
Possibilities of Bacterial, Chemical and Gas Poisoning of Public Water Supplies.....
Harry A. Faber
Report of New Jersey Section Water Supply Committee.....Wm. R. Conard
Round Table Discussion.....*Led By* Ed. Hyland and Vernon Smith

New York Section—Scheduled Papers—Spring Meeting

Address of Welcome.....*Mayor* Ernest W. Mirrington Jr.
History of the Water Works in Niagara Falls.....Fred V. H. Piper
Effect of the War on Water Works Operation.....Louis R. Howson
The Federal Bureau of Investigation in the National Defense Program.....K. M. Piper
Relations Between County Health Department and Local Water Supplies.....
A. H. Herberger
Procurement of Essential Water Works Materials.....Harry E. Jordan
The Construction and Installation of the Stone Canyon Reservoir Supply and Outlet Lines (*A Motion Picture*).....Thos. F. P. Kelly
A Discussion of Cathodic Tank Protection.....P. S. Wilson
The Water Works Officials Mutual Aid Plan.....Lewis B. Smith
Round Table—Purification of Water and General Supervision of Water Plants.....
Led by Paul G. Windt

New York Section—Scheduled Papers—Fall Meeting

Attendance at Chicago Wartime Conference (*A Motion Picture*).....E. A. Sigworth
Address of Welcome.....*Mayor* Erastus Corning II
Opening Remarks.....Earl Devendorf
Recent Developments as to Wartime Water Supply Problems.....Harry E. Jordan
Can American Water Works Provide for Civilian Protection?.....Robert C. Dennett
The Control of Water Supply Quality During the War.....Charles R. Cox
An Appraisal of Practical Aspects of the Protection of Water Supplies During the War.....Harry A. Faber
Review of the Olean Flood in Relation to the Mutual Aid and Civilian Protection Plans.....Alan D. Drake and Frank O'B. Nehin
Address.....Arthur E. Gorman
Office of War Training Programs.....*A Motion Picture*
Report of Committee on State War Council Group Meetings.....Wallace T. Miller
Report of War Inventory Committee.....Arthur T. Luce
"Information Please".....*Led by* A. F. Dappert

North Carolina Section—Scheduled Papers

Wartime Water Supply Problems.....J. W. Kellogg
Maintenance of Public Water Supplies for Civilian Defense.....D. W. Evans
Discussion.....Warren H. Booker
Address of Welcome.....*Mayor* W. F. Carr
The Value of Pitometer Distribution Studies to Meet Present Emergencies and Post-War Conditions.....E. Shaw Cole
Water Main Cleaning in the War Effort.....Clinton Inglee
Address.....Abel Wolman
A Superintendent's Nightmare.....M'Kean Maffitt
Certain Aspects of Water Supply to the Responsibility of the War Production Board..
Arthur E. Gorman
Shallow Well Field Operation Experiences at Elizabeth City.....R. W. Luther

Ohio Section—Scheduled Papers

Address of Welcome.....*Mayor* John Q. Carey
The Toledo Water Supply.....R. W. Furman
The Part the A.W.W.A. Can Play in the Present Emergency.....Harry E. Jordan
Protection of Water Works Facilities in Wartime.....F. H. Waring
The State Examiner Looks at a Water Works.....F. B. Thomas
Surface Washing of Filters.....James E. Specht
Discussion.....J. C. Britton, L. A. Marshall, A. V. Foltz
C. P. Hoover, W. I. Van Arnum
Problems Peculiar to Ground Water Supplies.....A. E. Kimberly
Substitute and Alternate Materials.....E. E. Smith
Report of Aims of A.W.W.A. Management Committee.....W. R. LaDue
Plant Management Problems.....O. F. Schoepfle
Preparation, Laying and Sterilization of Water Mains.....N. J. Humason
Discussion.....L. A. Marshall, L. S. Gettrust, C. E. Inman
The Construction and Installation of the Stone Canyon Reservoir Supply and Outlet Lines (*A Motion Picture*).....Thos. F. P. Kelly
Join the A.W.W.A. (*A Motion Picture*).....H. A. Moffat

Pacific Northwest Section—Scheduled Papers

Address of Welcome.....*Mayor* Herbert G. West
Response.....Fred D. Jones
Water Works Liabilities.....M. S. Campbell
Report of Committee on Safe Practices.....Brian Shera
Replacing and Re-Laying Water Mains.....J. H. Houser
Improvements in Bellingham Water System.....John Cunningham
Recent Developments in Corrosion Control.....J. Guy Eernisse
Description of Walla Walla Water System.....R. F. McLean
Asphaltic Enamel for Steel Water Pipe.....R. Harsch
Address.....Louis R. Howson
Preparation of Auxiliary Water Supply and Emergency Treatment.....Carl E. Green
Sabotage.....W. A. Groce
Civilian Defense as Applied to Spokane Water Works Air Raid Protection.....
James B. Fisken
Committee Report on Emergency Defense.....W. Chester Morse
Mutual Aid Plan for Water Service.....G. E. Arnold

Rocky Mountain Section—Scheduled Papers

Address of Welcome.....*Mayor* Ed Warren
Response.....Del Porter
The Construction and Installation of the Stone Canyon Reservoir Supply and Outlet Lines.....*A Motion Picture*
Ground Water Experiences, City of Laramie.....R. D. Goodrich
Geology of Rocky Mountain Region With Special Reference to Ground Water.....
S. H. Knight
The Geology and Development of Underground Water in Laramie County.....
Frank C. Foley
The Man Pursueth the Villain (*A Motion Picture*).....John Harris
Difficulties in Meeting Demands Placed on Utilities by a Military Cantonment.....
H. G. Watson
Construction and Installation of Transite Pipe.....*A Motion Picture*
Air Control in Water Pipe Lines.....Ben G. Davis
Construction and Installation of Spiral Welded Steel Pipe.....———
Health and the Cycle of Water.....*A Motion Picture*

Round Table Discussions:
Plant Protection ..... *Led by* K. E. Darling
Mutual Aid Plan, O.C.D. ..... *Led by* L. O. Williams, B. V. Howe and T. A. Filipi
Income Records ..... *Led by* E. R. Bancroft
Auxiliary Filter Wash Devices ..... *Led by* O. J. Ripple
Plant Operating Records ..... *Led by* Chester Truman
Stream Hardness ..... *Led by* Del Porter
Use of Calgon ..... *Led by* O. J. Ripple

Southeastern Section—Scheduled Papers

Georgia Water Works Emergency Mutual Aid Plan ..... W. H. Weir
Chemical Control of Water Supplies Under War Conditions ..... Harold B. Friedman
Bacteriological Control of Water Supplies Under War Conditions ..... Hugh A. Wycoff
Municipal and Industrial Water Supply Protection ..... F. R. Hammack
Handling Incendiary Bombs (*A Motion Picture*) ..... J. L. Ivey
Procurement of Essential Water Works Materials ..... Harry E. Jordan
Superintendents War Emergency Round Table ..... *Led by* B. P. Rice

Southwest Section—Scheduled Papers

Invocation ..... *Rev.* Fred G. Roebuck
Address of Welcome ..... *Mayor* Chas. E. Moyer
Remarks ..... Dan M. Boone
Remarks ..... W. A. McDonnell
Response ..... W. F. McMurry
Construction Problems of Little Rock's Water Supply (*Illustrated by Motion Pictures*) E. A. Elliott
Health and the Cycle of Water ..... *A Motion Picture*
Address ..... Chas. T. Evans
The Bombing of London ..... *A Motion Picture*
Panel Discussion—Sanitation Problems of Water Supply Systems Resulting From Defense Activities and Extraordinary Demands for Water Service:
The Relation Between the Small Public Water Supply and the State Health Department ..... *Led by* Walter A. Reiman
Cross-Connections for Auxiliary Supply ..... *Led by* F. W. MacDonald
Problems Resulting From Plant Expansion and Minimum Standards for Water Treatment Plants ..... *Led by* H. J. Darcey
Main Sterilization, New Installations and Repairs ..... *Led by* C. H. Billings
Recent Developments in Sterilization Treatment ..... *Led by* A. E. Griffin
Some Aspects of Filtration Plant Design and Operation ..... Edward R. Stapley
Discussion ..... A. H. Ullrich
The Disposal of TNT (Trinitrotoluene) Waste Waters and Its Relation to Public Water Supplies ..... Paul Hansen
The Importance of Water Works Systems and Their Protection in Our National Defense Work ..... H. T. Buchanan
The F.B.I. and National Defense ..... Fred Hallford
Civil Protection in Oklahoma City ..... M. B. Cunningham
Utility Operation and Civilian Protection ..... G. E. McCallum
Discussion ..... Carl E. Schwob
On the Water Works Front ..... Harry E. Jordan
Administrative Problems of Water Works Operation in Wartime ..... Homer A. Hunter
England—Its Civilian Protection and Utility and Industrial Operations in Wartime (*Illustrated by Motion Pictures*) ..... Davis M. DeBard
The Pollution of Public Water Supplies by the Use of Chemicals and Bacterial Cultures ..... Harry E. Barnes
Discussion ..... Harrison Hale

The Detection of Poisons in Water Supplies ..... O. M. Smith
Discussion ..... Harrison Hale
Priorities Clinic ..... C. S. Christian
Selective Service of the Essential Public Water Supply Operator and Deferment Procedure ..... E. L. Compere
Open Forum—Questions and Answers ..... *Led by* E. L. Olds
Pensions for Water Works Men ..... Wm. W. Brush
The Workings of Mutual Aid Plans in Water Supply ..... Linn H. Enslow
Discussion ..... Wm. W. Brush
Distribution System Economies Under Wartime Operation ..... W. R. Spencer
Discussion ..... A. S. Hatch

Virginia Sections—Scheduled Papers

What Is Expected From the National Standpoint ..... Gordon E. McCallum
Co-operation of Water Supply Organizations in Virginia ..... J. H. Wyse
The City of Norfolk ..... Charles B. Borland
The City of Newport News ..... E. F. Dugger
The City of Roanoke ..... Chas. E. Moore
The City of Richmond ..... Marsden C. Smith
Advantages of Attendance at A.W.W.A. Meetings (*A Motion Picture*) ..... W. A. Welch
Priorities for Water Works Material ..... Harry E. Jordan
Priority Effect on Large Installations ..... Reeves Newsom
The Cast-Iron Pipe Situation ..... Wilbur Winfree
The Meter Situation ..... M. J. Siebert
Water Works Laboratory Supplies ..... L. C. Bird
The Alum Situation ..... Fred E. Stuart
Emergency Sterilization of Water Mains ..... R. C. Clement
Effect of Municipal Water Treatment on Industrial Use ..... Albert E. Wilson Jr.
Question Box ..... *Led by* Richard Messer

West Virginia Section—Scheduled Papers

Address of Welcome ..... *Mayor* Earl Stevens
Response ..... Mentor Hetzer
Waste Water Survey at Wheeling ..... W. G. Yates
Developing a Large Underground Water Supply for Industrial Use ..... G. E. Hauer
First Year of Operation—Beckley's New Water Supply ..... E. E. Chandler
Mutual Aid Program ..... W. W. Towne
Current Status of Priorities ..... E. J. McClees
Scrap Collections at Water Works ..... Burman T. Mitchell
The American Water Works Association's Interest in Mutual Aid, Priorities and Salvage ..... Harry E. Jordan
Bill Jones Joins the American Water Works Association and Attends the National Conference in Chicago (*A Motion Picture*) ..... W. A. Welch
Symposium—Extending the Useful Life of Water Works Materials:
Repairs to Concrete Structures ..... Lee Davis
Emergency Repairs to Cast-Iron Pipe ..... H. Lloyd Nelson
Maintenance of Electric Motors ..... E. C. Jones
Welding as a Maintenance Tool for Water Works Equipment ..... L. E. Jones
Maintenance of Water Meters ..... John Devine
The Construction and Installation of the Stone Canyon Reservoir Supply and Outlet Lines ..... *A Motion Picture*
Round Table Discussion—Break-Point Chlorination ..... *Led by* P. D. Simmons

Western Pennsylvania Section—Scheduled Papers

Address of Welcome.....*Mayor* Cornelius D. Scully
Emergency Repair of Cast-Iron Pipe (*A Motion Picture*).....H. Lloyd Nelson
Priorities to Date.....Harry E. Jordan
Water Waste Prevention and Correction in Pittsburgh, Pa.....Homer E. Beckwith
An Up-to-Date Report on Gases and Poisons Affecting Water Supplies.....
W. M. Wallace
Demonstration of Spectrographic Analysis of Water.....Mary E. Warga
Wartime Effects on Health Departments.....A. Hamilton Stewart
Design and Operation of the Woodlawn Water Co. Softening Plant.....
E. F. Towmey and E. V. Grimshaw
Salvage of Water Works Materials.....John A. Beck

Wisconsin Section—Scheduled Papers

Greetings From the City of Wausau.....*Mayor* Herbert A. Giese
Opening Remarks.....Jerome C. Zufelt
National Salvage Program.....W. E. Simons
Valve Inspection and Maintenance.....Alvin J. Kuecker
Water—A Critical War Material.....Arthur E. Gorman
Emergency Chlorination.....L. L. Hedgepeth
Methods for the Detection of Poisons Affecting Water Supplies.....W. M. Wallace
Oil and Water—Development of a New Source of Water Supply at Centralia, Illinois..
Emmons W. DeBerard
Structural Requirements for Sanitary Well Construction.....Louis T. Watry
Development of Water Utility Organizations for Defense.....L. A. Smith
Discussion.....*Led by* N. J. Fisher
Mutual Aid Program.....O. J. Muegge
National Experience in Physical Protection of Utilities.....Herbert Brown
Necessary Legislation Needed to Permit Employees' Retirement Systems to Be Installed in Water Utilities.....Walter Staeffler
Timely Topics.....Harry E. Jordan
Water Works and the War Production Board.....F. J. Tharinger
Water Works and Priorities.....Herman Boll
Water Works Protection and National Defense.....William H. Cary Jr.

Section Meetings—1942

Section	*Meeting Place*	*Date*
California	Oakland, Calif.	Oct. 28–30
Canadian	Niagara Falls, Ont.	Apr. 15–17
Cuban	Havana, Cuba	Feb. 7
Florida	Miami, Fla.	Nov. 12–14
Four States	Philadelphia, Pa.*	Oct. 7–9
Illinois	Chicago, Ill.†	June 22
Indiana	Lafayette, Ind.	Apr. 9–10
Kentucky-Tennessee	Paducah, Ky.	Oct. 19–21
Michigan	No scheduled meeting	—
Minnesota	St. Paul, Minn.	Sept. 24–26
Missouri Valley	St. Louis, Mo.	Oct. 22–24
Montana	Helena, Mont.	Apr. 17–18
New England	No scheduled meeting	—
New Jersey	Trenton, N.J.	Mar. 26
	Philadelphia, Pa.*	Oct. 7–9
New York	Niagara Falls, N.Y.	Apr. 30–May 1
	Albany, N.Y.	Oct. 15–16
	New York, N.Y.	Dec. 30
North Carolina	Durham, N.C.	Nov. 3–4
Ohio	Toledo, Ohio	May 14–15
Pacific Northwest	Walla Walla, Wash.	May 8–9
Rocky Mountain	Cheyenne, Wyo.	Sept. 17–18
Southeastern	Atlanta, Ga.	Apr. 20
Southwest	Little Rock, Ark.	Oct. 12–14
Virginia	Richmond, Va.	Nov. 5–6
West Virginia	Parkersburg, W.Va.	Nov. 12–13
Western Pennsylvania	Pittsburgh, Pa.	Sept. 18
Wisconsin	Wausau, Wis.	Oct. 20–21

* Joint meeting of Four States and New Jersey Sections.

† Business meeting only—held at annual convention.

Section Membership at Time of, and Total Attendance at, Section Meetings—1938–42

SECTION	1938		1939		1940		1941		1942	
	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance
California	440	1,007	470	1,035	501	1,082	552	688	566	571
Canadian	217	415	222	445	219	367	262	*	266	410
Cuban	†	—	†	—	27	‡	35	‡	41	17
Florida	52	82	63	110	76	134	78	110	94	108
Four States	174	129	191	150	186	177	210	177	229	345¶
Illinois	181	184	194	§	199	226	197	152	284	*
Indiana	104	195	125	230	125	200	142	223	142	190
Kentucky-Tenn.	63	152	74	108	89	93	105	91	111	73
Michigan	88	192	99	218	116	233	124	245	122	‡
Minnesota	48	156	69	115	77	169	86	144	90	180
Missouri Valley	146	208	175	*	197	150	199	153	199	96
Montana	35	68	36	118	41	75	42	66	42	71
New England	127	‡	131	‡	137	‡	139	‡	144	‡
New Jersey**	174	150	205	136	218	172	221	134	211	184
New York‖	461	§	438	190	440	206	472	171	486	200
North Carolina	78	240	90	244	108	226	113	243	138	192
Ohio	†	—	139	136	163	198	173	118	182	146
Pac. Northwest	112	232	121	224	141	260	165	262	176	201
Rocky Mountain	74	95	79	131	87	123	88	84	83	86
Southeastern	134	*	143	222	157	222	166	192	196	130
Southwest	121	300	121	422	202	297	167	391	163	329
Virginia	49	100	53	94	53	103	68	153	77	117
West Virginia	†	—	54	145	63	168	65	125	69	113
Western Pa.	†	—	106	73	120	142	132	135	128	152
Wisconsin	72	233	73	258	76	238	89	237	106	215

* Regular meeting canceled. Business meeting held at annual convention.

† Section not organized.

‡ No regular meeting scheduled. Membership given as of date of annual convention.

§ No record of attendance.

‖ Three regular meetings held. Only Fall meeting recorded here.

¶ Joint meeting with New Jersey Section.

** Spring meeting recorded here. Fall meeting held jointly with Four States Section.

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Subject Index

A

Abbreviations; list of, for use in A.W.W.A. Journal, 164
Accountants; *see* Personnel
Accounting; *see also* Financing
  auditing; state; practices of, in Ohio, 1533
  cost; application of, to water utility administration, 564
    methods of, in maintenance of pumping station efficiency, in Chicago, 1411
  depreciation; principles of, at Jonesboro, Ark., 1500
  relation of, to management and operation, 849
  small water works; system of, at Camden, Tenn., 392
  statements; balance sheet; simplification of, 1880
    monthly issue of, advantages of, to management, 1887
  system of, under multiple-ownership water supply project, 383
Acid; well screen treatment with, 691
Activated carbon; *see* Carbon
Administration; *see* Management, Personnel, Public relations
Aerobacillus schuylkilliensis; isolation of, from Philadelphia drinking water, 365
Aftergrowths; control of, by ammonia-induced break-point chlorination, 275
Agitation; rock well development by, 691
Air raids; *see* War
Air-conditioning; water for, re-use of, promoted by rate surcharges, 1516
Algae; natural water softening by, at Los Angeles, 589
  plankton; effect of, in storage reservoirs, 733
Alkalinity; effect of, on chlorine kill, 357
  interpretation of, 1672
Allocation; *see also* Priorities
  end-use; plans for, 967
    Production Requirements Plan for; effect of new regulations on, 1126
    revocation of, 1923
Alloy-steel; procurement of, under recent W.P.B. rulings, 966
Alluvial deposits; ground water supply areas of, on Pacific Coast, 1616
Aluminum sulfate; A.W.W.A. emergency alternate specifications for, 1073
  A.W.W.A. standard specifications for, 1074
American Research Committee on Grounding, progress report of, 69
American Standards Association; graphical symbols for use on drawings, 313
  manhole frames and covers for subsurface structures, 1075
American Water Works Association; audit of association funds for 1941, report of, 426
  Board of Directors; action of, on Water Works Practice Committee report, 424
    resolutions of, re: wartime chlorination of water and protection of water plants, 468
  committee reports; control of chlorination, 1782
    cross-connections, 17
    survival and retirement experience with water works facilities, 1585
    water conditioning methods to inhibit corrosion, 1807
    water works practice, 412
  committees; American Research Committee on Grounding, progress of, 69
    directory of, *portion of a supplement to the June issue*
    municipal water works organization; organization and activities of, 1484
  conference on wartime water works problems, report of, 1927

Indiana Section Technical Committee; development of Bulletin No. 3 on emergency repairs to water distribution systems by, 1889
Journal of; abbreviations used in, 164
circulation statement of, as of September, 1926
manuscripts for, preparation of, 161
manuals; emergency repair of distribution systems, 1889
tentative; safe practice in water distribution, 915
membership directory, *a supplement to the June issue*
membership statement for 1941, 430
platform for, in the coming year, 979
policy of, in wartime protection of water supply quality, 1737
publications of, list of, 2009
section meetings—1942; report of, 1937
specifications; emergency alternate; sulfate of alumina, 1073
proposed; maintenance of steel standpipes and elevated tanks, 1556
standard; coal-tar protective coatings; use of, on Los Angeles aqueduct siphons, 1637, 1655
electric fusion welded steel water pipe; use of, on Los Angeles aqueduct siphons, 1653
elevated steel water tanks, standpipes and reservoirs, revisions in, 1915
laying cast-iron pipe; main sterilization recommedations of, 1778
sulfate of alumina, 1074
tentative; cold-water meters—displacement type; emergency alternate provisions for, 1914
war objectives—1942, 1295
Ammonia; *see also* Chloramines
relation of, to chlorine, in break-point chlorination, 276
Ammonia-chlorine treatment, *see* Chloramination
Analysis; *see also* Quality
attrition loss; accelerated tests for, of carbonaceous zeolites, 94
bacteriological; importance of chlorine in, 353
large water samples for, concentrating filter for, 585
size of samples in, 579
biological; identification of microorganisms by, 1559
chemical; of large public water supplies of Georgia, 505
of public water supplies of southeastern Florida, 1624
chlorine; in break-point investigations, 286
chlorine consumed; pollution testing by, 746
chlorine residual; methods of, 1788
new method of, 1227
colorimetric; ortho-tolidine dihydrochloride for, in chlorination control, 1782, 1786
flash color; modification of, for control of break-point chlorination, 1785
flow; *see* Hydraulics
fluoride; modification of standard method for, 522
ground water; problems of, 1597, 1614
natural water; graphical indication of minerals in, 335
organic pollution load; present status of, 1063
spectroscopic methods of, for organic pollution load, 1069
Ann Arbor, Mich.; water rate structure of, 381
Anthracite; use of, as filter medium, 1060
Antibiosis; effect of, on evaluation of coliform organisms in water, 579
Appearance; purification plant; importance of, to maintenance program, 238
Aqueducts; *see also* Pipe
steel siphons on, rehabilitation of, at Los Angeles, 1635
Aquifers; properties of, 685
Army; water supplies for, 11
Arsenite; reaction of, with chloramines, 1230
Artesian water; *see* Ground water
Attrition loss; carbonaceous zeolite; determination of, accelerated tests for, 94
Auditing; *see* Accounting
Automotive equipment; conservation of, 800
control of, by cost and efficiency reports, 567
decentralization of, during air raids, plans for, in Honolulu, 1150
tires for, Tire Rationing Board statement on, 1924
water distribution by, in wartime, 1312, 1752
Auxiliary personnel; *see* Personnel

B

Back-flow; control of, safe practice in, 917
Backwash; filter; velocity of, 1046
Bacteria; *Aerobacillus schuylkilliensis;* isolation of, from Philadelphia drinking water, 365
coliform; evaluation of, 577
combating, effectiveness of chlorine in, 353
distribution of, in natural waters, measurement of, 572, 577
Endameba histolytica; resistance of, to chlorine, 359, 363
gas-forming; incidence of, effect of de-chlorination and storage on, 1791
incidence of, relation of chlorine residuals to, 1789
increase of, in distribution systems, caused by sodium hexametaphosphate treatment, 1823
lactose-fermenting; sporulating; aerobic; isolation of, from Philadelphia drinking water, 365
non-spore-forming; types of, surviving chlorination, 1792
Bacteriology; *see* Analysis
Balance sheet; *see* Accounting; statements
Baltimore, Md.; maintaining efficiency of motor-driven centrifugal pumps in, 229
Bearings; pump; centrifugal; maintenance of, 217, 230
Beloit, Wis.; private water utility main extension rules at, 552
Billing; adequate records for, 1534
joint water and sewer account, 380
practices of, in cities of 100,000–200,000 population, 1527
Biochemical oxygen demand; determination of, as a measure of organic pollution load, 1066
Birmingham, Ala.; industrial water supply system of, comparison of estimated and actual consumption from, 569
Blackouts; *see* War
Boiler feed water; critical problems in, 1214
Bolts; corrosion of, inhibition of, 76
Bombing; *see* War
Bombs; anatomy, trajectory and effect of, 513
delayed action; experience with, in Britain, 183
Bonds; *see* Financing
Boonville, Mo.; maintenance of chlorine residual in the distribution system at, 1801
Bottling industry; water for, traveling laboratory control of, 1035
Break-point chlorination; *see* Chlorination
Britain; *see* Great Britain
Buildings; protection of, against bomb damage, in Britain, 188
war-damaged; rebuilding of, 1294

C

Calcium carbonate; solubility equilibrium of, 1667
Calcium hypochlorite; *see* Hypochlorites
Calgon; *see* Sodium hexametaphosphate
California; ground water problems in, 1615
larger cities of, methods of financing water main extensions in, 555
Southern; water quality problems of small systems in, 913
well pollution prevention in, 671
Cambridge, Mass.; tests on effect of sodium hexametaphosphate on solution of lead pipe at, 1415
Camden, Tenn.; self-sustaining small water works at, 390
Camouflage; *see* War
Canada; large rapid sand filtration plants in, design and operation data on, 1847
U.S. priorities for firms of, 831
wartime control of utilities in, 823
wartime control of public water supplies in, federal order on, 1739
wartime procurement problems of utilities in, 829
Carbon; activated; evaluation of, threshold method for, accuracy, application and procedure for, 900, 909
handling of, design provisions for, in South District Filtration Plant, 1392
treatment by, wartime modification of, 1756
Carbon dioxide; effect of, on pH in reservoirs, 722
free; effect of, on calcium carbonate solubility, 1675

Carbonaceous zeolites; attrition loss of, determination of, accelerated tests for, 94
Carbonate; lead; basic; solubility of, in dilute solutions, 85
Carryover; problem of, in boilers, 1215
Casings; pump; centrifugal; maintenance of, 210
Census; data of, on water treatment plants, summary of, 1831
Champaign, Ill.; promoting conservation of water by rate surcharges in, 1516
water service regulations of, wartime revision of, by Illinois Commerce Commission, 1736
Chemical feeders; chlorinators; fire pump; use of, to safeguard cross-connections, in Tennessee and New York, 22
design provisions for, in South District Filtration Plant, 1393
Chemicals; handling of, facilities for, at new Kansas City Plant, 707
treatment by, plans for, in South District Filtration Plant, 1397
Chemistry; *see* Analysis
Chicago; civilian defense plans for water safety control in, 1343
emergency repair of distribution systems in, 1210
pumping stations in, efficiency maintenance in, 1405
South District Filtration Plant; chemical building, design of, 1390
chemical treatment plans for, 1397
design of, conservation of critical materials in, 1381
Chloramination; methods of, for chloramine residual maintenance in the distribution system, 1797
Chloramines; reaction of arsenite with, 1230
residual; effectiveness of, in control of aftergrowths, 276
maintenance of, in distribution systems, 1804
Chlorination; *see also* Chloramination, Sterilization
break-point; ammonia-induced; chlorine residual maintenance by, in Houston, Tex., distribution system, 1799
practical application of, 275
application of residual chlorine determination to, 1234
control of, modification of flash color test for, 1785
Canadian government order on, in Vancouver, B.C., 1741
control of, standard methods for, committee progress report on, 1782
de-; effect of, on incidence of gas-forming bacteria, 1791
emergency practices of, in Chicago, 1347
main sterilization by; after emergency repairs, 1759, 1896
in new installations and repairs, 1777
methods of, for chlorine residual maintenance in the distribution system, 1797
protective measures of, in wartime London, 1298
reasons for, 354
survival of non-spore-forming organisms after, 1792
wartime modification of, 1757
wartime practices of; 1298, 1339, 1347
recommendations of A.W.W.A. Board of Directors on, 468
Chlorinators; fire pump; use of, to safeguard cross-connections, in Tennessee and New York, 22
Chlorine; *see also* Chloramines
available; measurement of, in hypochlorites, committee progress report on, 1783
bottling water treatment with, 1040
consumed; tests for pollution on the basis of, 746
demand; use of, as measure of organic pollution load, 1065
determination of, in break-point investigations, 286
handling of, design provisions for, in South District Filtration Plant, 1394
importance of, in water bacteriology, 353
priorities for; amendment to Order M-19, 174, *insert following p.* 334, 644
relation of, to ammonia, in break-point chlorination, 276
residual; bacteriological significance of, 356
determination of; new method for, 1227
various methods for, 1788
effectiveness of, in control of aftergrowths, 276
maintenance of, in distribution systems, 1797

measurement of, standard methods for, committee progress report on, 1783
relation of, to bacteriological quality, 1787
well capacity restoration with, 698
Chlorine-ammonia treatment; *see* Chloramination
Cinders; corrosive action of, on various bolting materials, 78
Civilian defense; *see* War
Clay; corrosive action of, on various bolting materials, 78
Cleaning; *see* Mains
Coagulation; problems of, in Chicago, 1399
wartime modification of procedures of, 1756
Coatings; specifications for, for Los Angeles aqueduct siphons, 1636, 1655
types of, for protection of bolting materials, 76
Coefficients; large pressure pipe; trends of, 523
Coliform organisms; *see* Bacteria
Collections; adequate records for, 1534
method of, for small water works, 397
practices in, in cities of 100,000–200,000 population, 1527
Columbus, Ohio; stabilization of lime-softened water at, 1425
Committee reports; *see* American Water Works Association
Communications; methods of, in wartime London, 1311, 1315
Concentration; effect of, on chlorine kill, 358
Concrete; specifications for, for use in dams, 1005
Conditioning; flocculation practices in, 404
Conduits; *see* Pipe
Connecticut; wartime guarding of water works property in, 1163
Conservation; *see also* Waste
critical materials; in water works equipment, 793
main cleaning for, 1771
methods of, in design of South District Filtration Plant, 1381
ground water; program for, 1605, 1621
promotion of, by rate surcharges, 1516
manpower; main cleaning for, 1771
power; main cleaning for, 1771
water; necessity of, in wartime London, 1318
ordinance enforcing, during flood emergency, at Olean, N.Y., 1749
Construction; materials requirements for, by U.S. public water supplies, 737
post-war; planning for, distribution system studies as aid in, 1762
priorities for, *see* Priorities
program for, importance of, 7
pump; relation of, to economical maintenance, 203
softening plant; at Kansas City, 703
well; sanitation in, 671
Consumption; allowances for, to Army, in the field and in cantonments, 12
domestic; maximum momentary demand for, studies on, 1538; *errata*, 1628
estimated and actual; comparison of, from Birmingham industrial supply system, 569
wartime increase of; distribution system studies help solve, 1762
provision for, by main cleaning program, 1771
Contamination; *see also* Pollution
dangers of, during flood emergency, at Olean, N.Y., 1750
drinking water; inhibition of, by control of cross-connections, 17
Contracts; multiple-ownership water supply project; accounting basis for, 383
well drilling; engineer's view of, 678
Control; break-point chlorination; modification of flash color test for, 1786
chlorination; committee progress report on, 1782
laboratory; of purification processes, wartime modification of, 1760
legal; application of, to ground water sources, 1604
quality; traveling laboratories for, in bottling industry, 1036
wartime aspects of, 1755
wartime measures of, A.W.W.A. policy on, 1737
water safety; Chicago civilian defense plans for, 1343
Controllers; rate-of-flow; maintenance of, 243
Controls; pump; maintenance of, 232
pumping station; modern trends in, 1256
purification plant; maintenance of, 237

Copper; end-use allocation of, 967
end-use information on, continued requirement of, under new priorities plans, 1923
procurement of, under recent W.P.B. rulings, 966
Copper sulfate; dispersion and settlement of, in storage reservoirs, 735
Cornell University Filter Plant; observations on filters at, 1055
Corrosion; *see also* Coatings, Painting
difficulties due to, control of by sodium hexametaphosphate, 1807
effects of, counteraction of, by metallizing, 1374
grounding as a cause of, 69
inhibition of; in bolting materials, 76
in elevated tanks and standpipes, 59, 63
prevention of; stabilization of lime-softened water with, 1434, 1438, 1449
Cost accounting; *see* Accounting
Costs; apportionment of, in multiple-ownership water supply project, 384
operation; wartime increase of, 1511
records of, good practice in, 1533
war; variation of, between municipal and private water works, 1514
water department; apportionment of, to city and consumers in sound rate structure, 375
Couplings; flexible; maintenance of, 232
sleeve type; emergency distribution system repairs with, 1897
Cross-connections; control of; 17
by Nassau County, N.Y., Department of Health, 845
safe practice in, 917
status of, in 1941, 31
plumbing; elimination of, 192
Customer relations; *see* Public relations

D

Dams; behavior of, in operation, 1014
damage to, in air raids, 1334
design and construction of, 984
river; relation of, to community water supplies, in T.V.A. area, 367
Dayton, Ohio; corrosion and scale problems at, 1438
Dead ends; chlorine residual maintenance at, 1803
De-chlorination; *see* Chlorination
Defense; *see* War
Density; bacterial; measurement of, 572, 577
Depreciation; *see* Accounting
Design; chemical building; for South District Filtration Plant, 1390
distribution system; distribution system studies as basis for, 1765
modern methods of, 234
rapid sand filtration plant; data on, for large cities of the U.S. and Canada, 1847
structural; conservation of critical materials in, 1381
Des Moines, Iowa; infiltration ground water supply at, 1610
management of water works at, 1491
Detroit; wartime administrative problems in, 1196
Development; deep well; by dynamiting, 684
rock well; by agitation, 691
Diagrams; indication of minerals in natural waters by, 335
Diesels; modern trends in, for pump drives, 1253
Dihydrochloride; ortho-tolidine; recommendation of, for colorimetric analyses in chlorination control, 1782, 1786
Dimouts; *see* War
Disease; *see also* Health
gastro-enteritis; combating, by chlorination, 363
poliomyelitis; virus of, resistance of, to chlorine, 358
wartime control of, by health departments, 1687
Disinfection; *see* Chlorination, Sterilization
Dissolved oxygen; *see* Oxygen
Distribution; water; costs of, records of, good practice in, 1534
emergency methods of, in wartime London, 1307, 1325
safe practice in, tentative manual for, 915
wartime problems of, in Richmond, Va., 1364
Distribution systems; *see also* Mains, Pipe, Services, Standpipes, Tanks, Valves
capacity of; increase of, by main cleaning, 1771
increase of, without using critical materials, 796
chlorine residuals in; maintenance of, 1797
relation of, to bacteriological quality, 1787

design of; distribution system studies as basis for, 1765
for Army supply, 12
design, construction and operation of, in U.S., 1027
disturbances in, caused by metaphosphate treatment, 1822
expansion of, with growth of small towns, difficulties in, 403
extensions to, *see* Extensions
flow analysis in, *see* Hydraulics
high-pressure; fire protection; cross-connection of, with public water supplies, 23
maintenance of, *see* Maintenance
pressure in, improvement of, by elevated tank, at Madison, Wis., 601
pumping station noises in, elimination of, 221
reconditioning of, at Milwaukee, 595
repair of, *see* Repair
sanitary and structural hazards in, provision against, 929
studies of, to solve wartime supply problems, 1762
tastes and odors in, prevention of, by maintenance of chlorine residual, 1798
wartime protection of, in Honolulu, 1142
Drawings; graphical symbols for use on, 313
Drilling; well; *see* Wells
Dynamiting; development of deep wells by, 684

E

Eau Claire, Wis.; restoring well capacity with chlorine at, 698
Education; health; wartime extension of, by health departments, 1687
Efficiency; maintenance of, in Chicago pumping stations, 1405
pump; maintenance of, 229
reports of, value of, to management, 565
Elevated tanks; *see* Tanks
Elgin, Ill.; maximum momentary demand for domestic consumption in, 1539
valve inspection and maintenance at, 1767
Elkhart, Ind.; maximum momentary demand for domestic consumption in, 1543
Emergencies; *see* War
Employees; *see* Personnel
Endameba histolytica; resistance of, to chlorine, 359, 363
End-use allocation; *see* Allocation
Engineering; state aid in, to New Mexico municipalities, 56
England; *see* Great Britain
Equilibrium; solubility; of calcium carbonate, 1667
Equipment; *see also* Materials
control; maintenance of, in water purification works, 237
replacement parts for, minimum requirements of, for proper maintenance, 241
distribution system; adequate stocks of, for emergency repairs, 1891
emergency repair; adaptation of standard mechanical parts for, 1904
list of, with manufacturers, 1913
manufacturers' publications on, 1912
ordering of, information required in, 1899
recommended stocks of, 1895
inventory of, for New York State mutual aid plan, 194
manufacturers of, maintenance service by, 240
pumping station; trends in, 1241
repair of, by metallizing, 210
shop; minimum requirements of, for maintenance of centrifugal pumps, 201
water works; survival and retirement experience with, 1585
Erie, Pa.; metallizing experience at, 1375
Evansville, Ind.; wartime administrative problems in, 1192
Excavations; street; repair of, methods of handling, 1545
Expenses; operating; data on, for small water works, 397
records of, *see* Accounting
Extensions; design of, distribution system studies as basis for, 1766
distribution system; planning for, by Hardy Cross method flow analysis, 264
main; financing of, in larger California cities, 555
installation of, problems and limitations of, 561
policies of, in Wisconsin, 544
procedure of, in Knoxville, 563
service; wartime problems of, 1190, 1192, 1196, 1202
wartime restrictions on, in Canada, 833

F

Facilities; *see* Equipment
Federal standards; water quality; application of, to evaluation of coliform organisms in water, 581
Feed water; boiler; critical problems in, 1214
Fermentation tube tests; evaluation of coliform organisms from, 577
Filters; backwashing of, velocity of, 1046
concentrating; design of, for large water samples, 585
design and operation of, fundamentals of, 1051
maintenance of, by metallizing, 1376
observations on, at Cornell University, 1055
rapid sand; perforated-pipe underdrains for, in U.S. and Canada, 857; *erratum*, 1414
sand for; expansion of, during backwash, 1048
grain size of, effect of, 1403
Filtration; conditioning of water before, by flocculation, 404
preparation of water for, problems with, in Chicago, 1398
protective measures of, in wartime London, 1298
rates of, wartime modification of, 1756
sludge-blanket; stabilization of lime-softened water by, 1433, 1446
Filtration plants; rapid sand; design and operation data on, for large cities in the U.S. and Canada, 1847
bibliography of, 1877
slow sand; list of, in large cities in the U.S. and Canada, 1877
U.S.; Census data on, summary of, 1831
Financing; *see also* Accounting
extension; methods of, in Knoxville, Tenn., 563
methods of, in larger California cities, 555
principles of, at Jonesboro, Ark., 1500
principles of, at Omaha, Neb., 1506
small water works; P.W.A. assistance in, at Camden, Tenn., 390
Fire hydrants; bypass connection of, in emergency distribution system repairs, 1901
rental for; see Rates, fire protection
Fire protection; allocation of costs to, in main extensions, 544
emergency supplies for, in Britain, 186
grading cities and towns for, standard schedule for, *following p.* 1584
high-pressure systems for, cross-connection of, with public supplies, 23
officials of; co-operation with, by water works officials, in New York State mutual aid plan, 193
water supplies for; cross-connections in, 19
maintenance of, during flood emergency, at Olean, N.Y., 1747
First aid; kits for, for war gas casualties, in Honolulu, 1157
Fittings; pipe; drawings of, graphical symbols for use on, 320
Flocculation; practices of, in conditioning, 404
Floods; protection against, at Olean, N.Y., relation of mutual aid and civilian protection programs to, 1743
Florida; southeastern; chemical character of public water supplies in, 1624
ground water supply in, 490
Flow; analysis of, *see* Hydraulics
coefficients of, in large pressure pipes, trends in, 523
Fluorides; determination of, modification of standard method for, 522
Foundations; dam; design and construction of, 987

G

Gages; pressure; maintenance of, 243
Gases; poison; first aid treatment for casualties of, kits for, used in Honolulu, 1157
warfare; contamination of water supplies by, 14
Gasoline engines; modern trends in, for pump drives, 1253
Gastro-enteritis; combating, by chlorination, 363
Gates; crest; design, construction and operation of, 1016
outlet; design and operation of, 1019
Geological Survey; *see* U.S.
Georgia; large public water supplies of, chemical character of, 505
Glendale, Calif.; testing and maintenance of small meters at, 716

Government; *see also* Regulations
federal; enlistment of personnel of, regulation of, 1734
state; control of water supplies in New York by, 842
engineering aid by, to New Mexico municipalities, 56
Grading; fire protection; standard schedule for, *following p.* 1584
Graphs; indication of minerals in natural waters by, 335
standard symbols for use on, 313
Great Britain; London; pumping stations in, during air raids, 1689
water service in, in wartime, 1298
main sterilization practice in, 1779
wartime water works maintenance in, 179
Ground water; *see also* Wells
chemical character of, in Georgia, 507
conservation of, promotion of, by rate surcharges, 1516
current problems in, 1595
Midwest problems of, 1606; *erratum*, 1784
Pacific Coast problems in, 1615
public supply by, in southeastern Florida, 490
sources of, capacity tests of, at Laramie, Wyo., 1629
South Dakota; treatment and supply problems in use of, 751
Grounding; American Research Committee on, progress report of, 69
Guarding; *see* War

H

Hardness; public water supply; in southeastern Florida, 1624
summary of, of larger water supplies of Georgia, 510
Hardy Cross method; flow analysis by, of large distribution systems, 247; *erratum*, 463
Hartford, Conn.; maximum momentary demand for domestic consumption in, 1540; *erratum*, 1628
Hawaii; Honolulu; wartime water works activity in, 1141
Hazards; flood; relation of mutual aid and civilian protection programs to, at Olean, N.Y., 1743
lead; study of, in drinking water, 85
sanitary and structural; provisions against, in water distribution, 917
war; evaluation of, in Chicago, 1344
Health; *see also* Disease
protection of, during flood, at Olean, N.Y., 1747
wartime problems of, met by health departments, 1685
Health departments; county; relation of, to local water supplies, 836
effect of war on, 1685
Hexametaphosphate; *see* Sodium hexametaphosphate
Honolulu, T.H.; wartime water works activity in, 1141
Housing; wartime projects in; water works problems with, 1197, 1203, 1762
Houston, Tex.; ammonia-induced breakpoint chlorination at, 275
chlorine residual maintenance in the distribution system at, 1797
current supply problems in, 1363
Hydrants; bypass connection of, in emergency distribution system repairs, 1901
rental for; *see* Rates, fire protection
Hydraulics; flow analysis; coefficients in, of large pressure pipe, trends in, 523
Hardy Cross method; application of, to large distribution system, 247
flow basin; study of, 407
Hydrology; investigations of, in U.S., 1026
mineral water analyses of, problems of mixtures in, 348
summary of, for Pacific Coast area, 1616
Hygiene; industrial; wartime extension of, by health departments, 1687
Hypochlorites; available chlorine in, measurement of, committee progress report on, 1783
priorities in, W.P.B. statement on, *insert following p.* 334

I

Illinois Commerce Commission; action of, on rate surcharges, to promote water conservation, 1521
wartime revision of water service regulation by, 1736
Immunization; wartime extension of, by health departments, 1687
Impellers; centrifugal pump; maintenance of, 219
noncritical materials for, 801

Indiana; state accounting control in, 850
Indiana Section Technical Committee; development of Bulletin No. 3 on emergency repairs to water distribution systems by, 1889
Indianapolis, Ind.; flocculation practice at, 408
maximum momentary demand for domestic consumption in, 1544
wartime administrative problems in, 1201
Industrial hygiene; wartime extension of, by health departments, 1687
Industrial water supply; *see* Supplies
Industry; co-operation of, in salvage drive, 1369
war; enlistment of men in, regulation of, 1734
water service to, in Ohio, 1360
Infiltration; river bed; public ground water supply by, 1610
Intakes; relocation of, in navigation improvements, responsibility for, 367, 487
Inter-connections; plumbing; control of, safe practice in, 917
elimination of, 17, 192
supply; New York State mutual aid plan for, for water service in emergencies, 192
plans for, in Nassau County, 837
suggested change in terminology, 838
Inventories; distribution system equipment; size and dispersion of, for emergency repairs, 1891
emergency repair equipment; recommendations for, 1895
mutual aid; 1174
wartime reduction of, 834
Investments; *see* Financing
Irrigation; water for, graphical indication of minerals in, 335

J

Jackson turbidimeter; use of, in accelerated tests for determination of attrition loss of carbonaceous zeolites, 94
Jointing; specifications for, for Los Angeles aqueduct siphons, 1661
Joints; mechanical; emergency distribution system repairs with, 1208, 1897
ordering of, information required in, 1899
non-critical materials for, 801
Jonesboro, Ark.; successful water works management at, 1496
Journal; *see* American Water Works Association

K

Kansas City, Mo.; wartime administrative problems in, 1193
water softening plant for, 703
Knoxville, Tenn.; main extension policy of, 563

L

Labor; *see* Personnel
Laboratories; traveling; design and use of, for water for the bottling industry, 1036
Laboratory control; wartime modification of, 1760
La Crosse, Wis.; treating well screens with acid at, 695
La Grange, Ill.; corrosion and scale problems at, 1438
Laramie, Wyo.; capacity tests of ground water sources at, 1629
Lava flows; tertiary; ground water supply areas of, on Pacific Coast, 1618
Law; application of, in property damage by navigation improvements, 368, 487
to control of local water supplies in New York State, 842
to sewage treatment practice, in North Carolina, 53
authorization of mutual aid plan by, 1178, 1186
easement of, for navigation improvement, 368, 487
municipal responsibility for polluted water under, in Minnesota, 37
Lead; effect of, on safety of drinking water, 85
solution of, effect of sodium hexametaphosphate on, 1415
Lead carbonate; basic; solubility of, in dilute solutions, 85
Lead sulfate; solubility of, in dilute solutions, 85
Leaks; water waste by, prevention and correction of, in Pittsburgh, 1523
Liability; *see* Law
Lima, Ohio; substitute and alternate materials for service pipe at, 1042
Lime; water softening by; stabilization after, 1425

Limnology; observations on, of San Francisco reservoirs, 719
London; *see* Great Britain
Los Angeles; elimination of pumping station noises from distribution system of, 221
Owens River Aqueduct; steel siphon rehabilitation on, 1635
wartime guarding of water works property in, 1169
water system of, unusual natural water softening in, 589

M

Madison, Wis.; erection of new elevated tank at, 601
Magnesium silicate scale; control of, by sodium hexametaphosphate, 1452
Maine; mutual aid plan at work in, 1173
Maine Water Utilities Association; development of mutual aid plan by, 1173
Mains; *see also* Distribution systems, Pipe, Services
air-raid damage to, in wartime London, 1309
cleaning of; critical materials conservation by, 796, 1296
distribution system capacity increased by, to provide for increased wartime demands, 1771
corrosion of, *see* Corrosion
extensions to; *see* Extensions
flow analysis of, *see* Hydraulics
laying of, experiences in, in Milwaukee, 595
location of, records of, importance of, for emergency repairs, 1893
maintenance of, *see* Maintenance
pollution in; precautions against, in wartime London, 1304
repair of, *see* Repair
sterilization of; after emergency repairs, 1318, 1759, 1896
in new installations and repairs, 1777
suction line; potable water; provision against sanitary and structural hazards in, 925
Maintenance; *see also* Repair
control equipment; methods of, in water purification works, 237
distribution system; street excavations for, methods of handling, 1545
wartime planning for, 1205, 1889
efficiency; in Chicago pumping stations, 1405
elevated tank; good and bad practices in, 1552
methods and practices in, 59, 63
emergency materials stores for, in Honolulu, 1144
equipment; necessity of, in wartime, 793
filter; backwash efficiency in, 1045
main; program for, in Milwaukee, 273
materials requirements for, by U.S. public water supplies, 737
metallizing in, 210, 1374
meter; large; program of, in Nashville, Tenn., 122
practice in San Francisco, 712
values of, 117
motor; methods of, 231
priorities for, *see* Priorities
pump; centrifugal; methods of, employed by St. Louis County Water Co., 200
routine program for, 205
pumping station equipment; in Chicago, 1411
services; program for, in Milwaukee, 273
standpipe; methods and practices in, 63
street; methods of, after distribution system repair excavations, 1545
valve; program for, at Elgin, Ill., 1769
recommended practice in, during emergencies, 1890
Management; *see also* Public relations
benefits to, by monthly balance sheet statements, 1880
combined utilities; benefits of, 1497
good practice in, 1483
principles of, at Jonesboro, Ark., 1496
problems of, in wartime, 1189
program of, for efficient operation, 1
recommended practices in, by Ohio state examiners, 1533
small water works; practices of, 390, 402
sound principles of, 1489
relation of accounting to, 849
value of cost and efficiency records to, 564
Manganese; removal of, from South Dakota ground waters, 752
Manholes; frames and covers for; A.S.A. specifications for, 1075

Manpower; *see* Personnel
Manuals; *see* American Water Works Association
Manufacturers; water works equipment; maintenance service by, 240
publications of, on main repair equipment, 1912
Manuscripts; preparation of, guide for, for A.W.W.A. Journal, 161
Maps; *see* Records
Materials; *see also* Equipment
alternate; types of, available for services, 1042
construction and maintenance; requirements of, by U.S. public water supplies, 737
copper and alloy-steel; procurement of, under W.P.B. rulings, 966
critical; conservation of; by main cleaning, 1771
in design of South District Filtration Plant, 1381
in water works practice, methods of, 793
list of, for project ratings, 657
priorities regulations on; *see* Priorities
distribution system; adequate stocks of, for emergency repairs, 1891
emergency stores of, for water supply defense in Honolulu, 1144
inventories of; for operation of mutual aid plan, 1174
reduction of, in wartime, 834
substitute; employment of, in Houston, Tex., 1363
types of, available for services, 1042
U.S.; Canadian reliance upon, 831
wartime control of, in Canada, 823
Maximum momentary demand; studies on, 1538; *erratum*, 1628
Metallizing; repair of centrifugal pump equipment by, 210
water works maintenance by, 1374
Metals; copper-alloy; end-use information on, continued requirement of, under new priorities plans, 1923
effect of sodium hexametaphosphate on, 1812
meter; conservation of, 794
priorities regulations on, *see* Priorities
requirement of, for U.S. public water supply construction and maintenance, 737
spraying of, *see* Metallizing
Metaphosphate; *see* Sodium hexametaphosphate
Meters; cold-water; displacement type; A.W.W.A. specifications for, emergency alternate provisions for, 1914
critical materials for, conservation of, 794
large; comprehensive survey of, in Nashville, Tenn., 121
maintenance of, values of, 117
mercury-float; maintenance of, 245
piston type; repair procedure for, 128
pumping station; modern trends in, 1256
reading of, schedule of, for small water works, 397
rotary; repair procedures for, 127
small; testing and maintenance of, at San Francisco, 712
testing of, 118, 122, 712
Micromet; *see* Sodium hexametaphosphate
Micro-organisms; identification of, in relation to water purification, 1559
Midwest; ground water problems of, 1606; *erratum*, 1784
Milwaukee, Wis.; corrosion study of bolting materials and coatings at, 76
main laying in, 595
main maintenance practice in, 272
wartime administrative problems in, 1189
Minerals; graphical indication of, in natural waters, 335
Minnesota; legal responsibility of municipalities of, for polluted water, 37
Missouri River; navigation improvements on, relation of, to valley properties, 475
Moraines; glacial; ground water supply areas of, on Pacific Coast, 1618
Most probable number; estimation of, by simple formula, 572
replacement of, by most probable range, 577
Most probable range; replacement of most probable number by, 577
Motors; centrifugal pump; maintenance of, 231
electric; modern trends in, for pump drives, 1249
Muck; corrosive action of, on various bolting materials, 78

Municipal ownership; *see* Ownership
Municipalities; development of, ground water as a factor in, 1623
state engineering aid to, in New Mexico, 56
Mutual aid; *see* War

N

Nashville, Tenn.; comprehensive survey of large meters in, 121
maximum momentary demand for domestic consumption in, 1542; *erratum*, 1628
Nassau County, N.Y., Health Department; relation of, to local water supplies, 836
National Board of Fire Underwriters; standard schedule for grading cities and towns of the U.S. with reference to their fire defenses and physical conditions, *following p.* 1584
Navigation; improvements to, relation of, to Missouri River valley properties, 475
New Jersey; North Jersey District Water Supply Commission; Wanaque project of, accounting organization of, 383
New Mexico; state engineering aid to municipalities in, 56
New York Office of Civilian Protection; organization and training of emergency repair crews and auxiliary personnel for emergency duty by, 803
New York State; mutual aid plan for water service in emergencies in, 189, 1179
southwestern; flood in, operation of mutual aid and civilian protection programs during, 1743
New York State Sanitary Code; control of local water supplies under, 842
Newport News, Va.; current supply problems in, 1362
Nitrite reagent; effect of residual chlorine on, 1236
Noises; pumping station; elimination of, from distribution systems, 221
North Carolina; legal aspects of sewage treatment in, 53
North Jersey District Water Supply Commission; Wanaque project of, accounting organization of, 383

O

Occupational classification; selective service rules on, 970
Odors; *see* Tastes and odors
Office of Production Management orders; *see* Priorities
Ohio; investigations of water works protection in, 1357
state accounting examination in, 1537
Olean, N.Y.; flood at, review of, in relation to mutual aid and civilian protection programs, 1743
Omaha, Neb.; successful water works management at, 1503
Operation; efficiency in, recommendations for, 1
expenses and records of, for small water works, 397
rapid sand filtration plant; data on, for large cities of the U.S. and Canada, 1847
relation of accounting to, 849
Operators; *see* Personnel
Organic matter; effect of, on chlorine kill, 357
Organic pollution load; tests for, present status of, 1063
Organization; revision of, to promote operating efficiency, 1
Ortho-tolidine; colorimetric analyses with, in chlorination control, committee progress report on, 1782
modification of, for control of breakpoint chlorination, 1786
Ortho-tolidine dihydrochloride; recommendation of, for colorimetric analyses in chlorination control, 1782, 1786
Outlets; dam; design and operation of, 1019, 1021
Ownership; effect of, on wartime water works costs, 1514
multiple; wholesale rates under, in Wanaque supply project, 388
municipal; legal aspects of sewage treatment under, in North Carolina, 53
legal responsibility for polluted water under, in Minnesota, 37
management and operation of small water works under, 390
private; financing of main extensions under, 551
public; benefits of, 1490, 1503

Oxygen; dissolved; determination of, as a measure of organic pollution load, 1068
factors controlling changes in, in reservoirs, 721

P

Pacific Coast; ground water problems on, 1615
Painting; corrosion inhibition by, in elevated tanks and standpipes, 67
frequency of, in maintenance of elevated tanks, 61
Papers; preparation of, guide for, for A.W.W.A. Journal, 161
Paterson, N.J.; maximum momentary demand for domestic consumption in, 1542
Pennsylvania; mutual aid plan at work in, 1179
north-central; flood in, operation of mutual aid and civilian protection programs during, 1743
Pennsylvania Department of Health; effect of war on, 1685
Peoria; shallow ground water supply at, 1612; *erratum*, 1784
Perforated-pipe underdrains; use of, for rapid sand filters in the U.S. and Canada, 857; *erratum*, 1414
Personnel; accountants; relation of, to superintendents, 849
auxiliary; organization and training of, for emergency water service duties, 803
proper use of insignia for, 1752
conservation of; main cleaning for, 1773
wartime necessity of, 802
emergency repair; organization and work of, 803, 1147, 1211, 1349, 1889
federal; enlistment of, regulation of, 1734
health department; problems of, caused by war, 1685
inventory of; as basis for long-term planning, 1591
for New York State mutual aid plan, 194
occupational classification of, selective service rules on, 970
organization of, for water supply protection, in Chicago, 1349
preparation of, for emergency duty, in Honolulu, 1147
requirements of; for centrifugal pump maintenance, 202
for efficient operation, 2
salary increases to, War Labor Board order and statement on, 1925
selective service policies on; changes in, re: dependency and nature of occupation, 1289
review of, in relation to long-time manpower planning, 1591
small water works; full-time *vs.* part-time operators for, 394
superintendents; qualifications of, 1492
relation of, to accountant, 849
trained; availability of, for emergency distribution system repairs, 1896
traveling laboratory; organization and duties of, in bottling industry, 1037
war industry; enlistment of, regulation of, 1734
wartime reduction of, 834
wartime work shift system for, in London pumping stations, 1690
water works; wartime problems with, 1189, 1192, 1193, 1201
Personnel relations; defense measures in, 470
pH; effect of, on chlorine kill, 357
effect of, on residual chlorine determination, 1233
factors controlling changes in, in reservoirs, 722
Philadelphia; drinking water of, isolation of an aerobic sporulating lactose-fermenting organism from 365
water works at, rehabilitation of, 107
Phosphates; glassy; *see* Sodium hexametaphosphate
Pipe; *see also* Aqueducts, Distribution systems, Mains, Services
coating of, *see* Coatings
corrosion of, *see* Corrosion
drawings of; graphical symbols for use on, 318
effect of sodium hexametaphosphate on, 1812
fittings for; drawings of; graphical symbols for use on, 320
flow analysis in, *see* Hydraulics
grounding electrical currents to, effect of, 69
joints in, *see* Joints
laying of, methods of, for Los Angeles aqueduct siphons, 1666
lead; effect of sodium hexametaphosphate water treatment on, 1415

maintenance of, *see* Maintenance
pressure; large; trends in coefficients of, 523
pumping station; modern trends in, 1254
repair of, *see* Repair
specifications for; for Los Angeles aqueduct siphons, 1635, 1653
transportation and handling of, on Los Angeles aqueduct siphons, 1637, 1659
Pitometer surveys; solution of wartime supply problems by, 1523, 1762
Pittsburgh; water waste prevention and correction in, 1523
Plankton; effect of, in storage reservoirs, 733
Plugs; wood; temporary repairs by, 1209
Plumbing; *see also* Cross-connections, Inter-connections
equipment for; back-flow from, control of, 917
drawings of, graphical symbols for use on, 315
toilets; effects of, on rates of water consumption, 1538
Policing; *see* War; guarding
Poliomyelitis; virus of, resistance of, to chlorine, 358
Politics; wartime moratorium on, 1204
Pollution; *see also* Contamination
chlorine consumed tests for, 746
organic load of, tests for, present status of, 1063
precautions against, in wartime London, 1302
water; legal responsibility of municipalities for, in Minnesota, 37
well; prevention of, 671
Pontiac, Ill.; water service regulations of, wartime revision of, by Illinois Commerce Commission, 1736
Portions; size of, effect of, in evaluation of coliform organisms, 579
Portland, Me.; wartime guarding of water works property in, 1168
Potassium permanganate demand; use of, as measure of organic pollution load, 1065
Power; auxiliary sources of, development of, for defense of water works, 194
conservation of, by main cleaning, 1771
electric; costs of, data on, for small water works, 395
Power apparatus; drawings of, graphical symbols for use on, 324
Preference ratings; *see* Priorities
Pressure; service; improvement of, by new elevated tank, at Madison, Wis., 601
Prices; wartime control of, in Canada, 823
Priorities; *see also* Allocation
alloy-steel procurement under, 966
Canadian; utility control by, 832
chlorine; amendment to order M-19, 174, *insert following p.* 334, 644
construction; Conservation Order L-41, 785
Controlled Materials Plan; announcement and description of, 1917
copper procurement under, 966, 1923
effect of, on purification works maintenance practices, 237
hypochlorites; W.P.B. statement on, *insert following p.* 334
maintenance; assignment of AA-1 rating to, 1917
materials requirements for U.S. public water supply construction and maintenance as a basis for, 717
obtaining higher ratings in, 1482
preference ratings; application for, Form PD-1A for, 464
certificates; listing of, pursuant to Conservation Order L-41, 791
revision of, by Regulation No. 3, 328
methods of making, Administrative Letter No. 7 on, 1717
Order 10; revocation of, 1923
Order P-46; administrative letters on, 959, 962, 1717
amendments to, 168, 661, 1130, 1294, 1723
latest form of, as of October 10, 1723
Order P-46a; amended form, as of October 10, 1733
orders; listing of, pursuant to Conservation Order L-41, 791
problems of, in Newport News, Va., 1362
Production Requirements Plan; effect of new regulations on end-uses of materials, 1126
plans for, 967
revocation of, 1923
project ratings; applications for, Forms PD-200 and PD-200A for, 654
Regulation No. 3; revised preference rating certificates, 328

repair; assignment of AA-1 rating to, 1917
special assistance in, for emergencies, 964
U.S.; application of, to Canadian firms, 831
utilities, maintenence, repair and supplies; amendments to Order P-46, 168, 661, 959, 1130, 1294, 1717, 1723
Private ownership; *see* Ownership
Production; water; costs of, records of, good practice in, 1534
Production Requirements Plan; *see* Priorities
Project ratings; *see* Priorities
Property; damage to, in navigation improvement, laws on, 368, 487
guarding of, *see* War; guarding
Public ownership; *see* Ownership
Public relations; improvement of, by use of simplified balance sheet, 1880
maintenance of, in change-over to softened water, 1428
requirements in, for efficient operation, 3
wartime measures of, in Honolulu, 1152
wartime problems of, 1203
Publications; manufacturers'; on main repair equipment, 1912
manuscript preparation for, guide for, 161
Pumping; heads, raising of, to increase distribution system capacity without using critical materials, 798
wartime problems of, in Richmond, Va., 1364
Pumping stations; damage and protection of, in air raids, 1333
efficiency maintenance in, in Chicago, 1405
equipment for, modern trends in, 1241
potable water; provision against sanitary and structural hazards in, 926
problems of, during air raids, in Britain, 1689
Pumps; centrifugal; distribution system noises caused by, 222
maintenance of, 200
motor-driven; efficiency of, maintenance of, 229
concentrating filter attachment for, to collect large water samples, 585
distribution system noises caused by, elimination of, 221
drives for; various types of, modern trends in, 229, 1248
maintenance of, by metallizing, 210, 1379
mobile; use of, in air raids, 1690
various types of, modern trends in, 1241
Purchases; materials and supplies; methods of, for small water works, 399
Purification; *see also* Treatment
control equipment in, maintenance of, 237
laboratory control of, wartime modification of, 1760
mobile equipment for, for Army water supply, 13
relation of micro-organism identification to, 1559
wartime problems in, in Richmond, Va., 1364
Purification plants; data on, 1831, 1847

Q

Quality; bacteriological; relation of chlorine residual to, 1787
chemical; summary of, for larger water supplies of Georgia, 506
drinking water; effect of lead salts on, 85
federal standard of, application of, to evaluation of coliform organisms in water, 581
ground water; southeastern Florida, summary of, 497
problems of, in small systems, 911
protection of, during flood emergency at Olean, N.Y., 1750
requirements of, for bottling industry water supplies, 1035
standards of, wartime control of, by federal government, in Canada, 1739
wartime control of, 1755
wartime protection of, A.W.W.A. policy on, 1737

R

Rates; fire protection; absorption of main extension costs in, 544
administration of, at Omaha, Neb., 1507
proportion of water department costs to be collected by, 375, 380, 544
sound basis for, development of, 374

structure of, in Ann Arbor, Mich., 381
surcharges on, to promote water conservation, 1516
wartime control of, in Canada, 823
wartime effects on, 1511
wholesale; in Wanaque multiple-ownership water supply project, 388
Rating; fire protection; standard schedule for, *following p.* 1584
Rationing; tire; statement on, 1924
Raymond Basin, California; safe ground water yield of, 1619
Recarbonation; stabilization of lime-softened water by, 1425
Records; *see also* Accounting
cost and efficiency; value of, to water utility administration, 564
distribution system; importance of, for emergency repairs, 1893
importance of, for operating efficiency, 7
importance of, for water supply protection, 1357
operation; relation of, to proper maintenance of centrifugal pumps, 204
types of, for small water works, 397
value of, to management and operation, 853
valve location; importance of, 1767, 1890
value of, during flood emergency, at Olean, N.Y., 1751
water works; good practice in, 1533
Red water; control of; sodium hexametaphosphate for, 1809
Regulations; *see also* Government
Canadian; on treatment of public water supplies, 1739
state; application of, to control of local water supplies in New York, 842
water service; wartime revision of, by Illinois Commerce Commission, 1736
Repair; *see also* Maintenance
distribution system; emergency methods of, 1205
manual on, 1889
permanent *vs.* temporary methods of, 1897
main; after bomb damage, in Britain, 182, 1309
emergency methods of, organization and training of auxiliary personnel for, 803
program for, in Milwaukee, 272
sterilization practice in, 1759, 1777, 1896
street excavations for, methods of handling, 1545
meter; procedure for, 127
priorities for, *see* Priorities
program for, during air raids, in Britain, 179
valve; procedure of, at Elgin, Ill., 1768
Replacement parts; *see* Equipment
Reports; *see* Records
Reservoirs; distribution; steel; A.W.W.A. specifications for, revisions in, 1915
emergency; use of, for water for fire protection, in Britain, 186
ground storage; use of, to increase distribution system capacity without using critical materials, 798
ground water; functioning of, 1599
impounding; relation of, to community supplies, in T.V.A. area, 367
unusual natural water softening in, at Los Angeles, 589
potable water; provision against sanitary and structural hazards in, 921
service; pollution in, precautions against, in wartime London, 1304
storage; chlorine residual maintenance in, 1800
limological observations on, at San Francisco, 719
Residual chlorine; *see* Chlorine
Retirement; equipment; experience with, committee progress report on, 1585
Reynolds number; application of, in flow studies, in large pressure pipes, 523
Richmond, Va.; current supply problems in, 1364
Riparian owners; subordinate status of, in navigation improvement laws, 368, 487
Ripon, Wis.; private water utility main extension rules at, 552
Rivers; navigation improvement in, relation of, to valley properties, 367, 475
Rivets; conventional; drawings of; graphical symbols for use on, 325
tank; replacement of, racketeering in, 1553
Roanoke, Va.; maximum momentary demand for domestic consumption in, 1541

S

Sabotage; *see* War
Safety; *see* Hazards
St. Louis County Water Co.; centrifugal pump maintenance practice of, 200
emergency repair of distribution systems by, 1205
Salinity; effect of, on calcium carbonate solubility products, 1670
Salt water; intrusion of, in ground water of southeastern Florida, 499
Salts; graphical indication of, in natural waters, 335
Salvage; importance of, to war effort, 1367
Samples; bacteriological; de-chlorination and storage of, effect of, on incidence of gas-forming bacteria, 1791
size of, effect of, in evaluation of coliform organisms, 579
water; large; concentrating filter for, design of, 585
Sampling; bacteriological; program for, at Boonville, Mo., 1803
San Francisco; maximum momentary demand for domestic consumption in, 1539; *errata*, 1628
meter testing and maintenance at, 712
reservoirs at, limnological observations on, 719
Sand; corrosive action of, on various bolting materials, 78
filter; expansion of, during backwash, 1048
grain size of, effect of, 1403
Saturation; calcium carbonate index of, 1676
Scale; magnesium silicate; control of, by sodium hexametaphosphate, 1452
silica; problem of, in boilers, 1220
Screens; well; acid treatment of, 695
Selective service; advice on, re: long-term personnel planning, 1591
changes in policy, re: dependency and nature of occupation, 1289
occupational classification under, rules on, 970
Service; extensions of; *see* Extensions
maintenance of, during flood emergency, at Olean, N.Y., 1747
regulation of; wartime revision of, by Illinois Commerce Commission, 1736
Services; *see also* Distribution systems, Pipe
grounding electrical currents to, effect of, 69
non-critical materials for, 800
repair of, program for, in Milwaukee, 273
substitute and alternate materials for, 1042
Sewage; treatment of, legal aspects of, in North Carolina, 53
Sewers; service charges for, joint collection of, with water bill, 380
Shafts; pump; centrifugal; maintenance of, 217
Shooting; development of deep wells by, 684
Silica; removal of, from boiler feed water, 1220
Silicate; magnesium; scale of, control of, by sodium hexametaphosphate, 1452
Siphons; steel; rehabilitation of, on Los Angeles aqueduct, 1635
Sleeves; pump; centrifugal; maintenance of, 212
Sloughing; increase of, in distribution systems, caused by sodium hexametaphosphate treatment, 1822
Sodium hexametaphosphate; action of, theory of, 1809
application of, to piping systems, 1812
distribution system disturbances by, 1822
effect of, on solubility of lead salts in water, 85
effect of, on solution of lead, 1415
history of use of, in control of difficulties due to corrosion in water supply systems, 1808
magnesium silicate scale control with, 1452
treatment with; applications of, 1828
economics of, 1824
failure of, instances of, 1823
inadequacy of, 1828
value of, in control of difficulties due to corrosion in water supply systems, 1807
Softening; change-over to, minimizing public disapproval of, 1428
lime; stabilization of water after, 1425
natural; unusual case of, in Los Angeles water system, 589
new plant for, at Kansas City, 703
Solubility equilibrium; of calcium carbonate, 1667

South Dakota; supply and treatment problems in, 749
South District Filtration Plant; *see* Chicago
Specifications; *see* also American Standards Association, American Water Works Association
jointing and welding; for Los Angeles aqueduct siphons, 1661
pipe and coating, for Los Angeles aqueduct siphons, 1635, 1653, 1655
well drilling contract; recommendations for, 680
Spectroanalysis; application of, to determination of organic pollution load, 1069
Spillways; dam; design, construction and operation of, 1016
Springfield, Ohio; corrosion and scale problems at, 1438
Stabilization; methods of, for lime-softened water, 1425
Standards; *see* American Standards Association, American Water Works Association, Quality, Specifications
Standpipes; maintenance of; 63
good and bad practices in, 1552
steel; A.W.W.A. specifications for, revisions in, 1915
Statements; *see* Accounting, Records
Steel; alloy; procurement of, under recent W.P.B. rulings, 966
end-use allocation of, 967
Steel plate; specifications for, for Los Angeles aqueduct siphons, 1635
Sterilization; *see also* Chloramination, Chlorination
chlorine for, theory of, 362
drinking water; instructions to public on, in wartime London, 1307, 1323
main; methods of, after emergency repairs, 1209, 1318, 1759, 1896
methods of, in new installations and repairs, 1777
specifications of A.W.W.A. on, 1778
wartime practices of, in Britain, 185
Stocks, *see* Inventories
Storage; effect of, on incidence of gas-forming bacteria, 1791
ground water; functioning of, 1599
increase of, by water spreading, 1621
stabilization of lime-softened water by, 1431, 1446
water; for air-raid defense, 969
Streams; navigation improvement on, relation of, to valley properties, 367, 475
Suburban areas; water main extensions to, 544, 555, 561
Suction; pump; importance of, in maintaining efficiency, 235
Sulfate; lead; solubility of, in dilute solutions, 85
Sulfate of alumina; A.W.W.A. emergency alternate specifications for, 1073
A.W.W.A. standard specifications for, 1074
Super-chlorination; *see* Chlorination
Superintendents; *see* Personnel
Supplies; *see also* Ground water
army; procurement and purification of, 11
Canadian; wartime control of, by federal government, 1739
current problems of, 1362, 1762
emergency; private wells for, in wartime London, 1315
fire protection; cross-connections in, 19
grading of, standard schedule for, *following p.* 1584
maintenance of, during flood emergency, at Olean, N.Y., 1747
industrial; cross-connections in, 19
estimated and actual consumption from, at Birmingham, Ala., 569
insuring adequacy of, by distribution system studies, 1762
traveling laboratory control of, for bottling, 1035
wartime problems of, met by health departments, 1686
local; relation of county health department to, 836
protection of; *see* War
public; Georgia; chemical character of, 505
southeastern Florida; chemical character of, 1624
relation of river dams to, in T.V.A. area, 367
South Dakota; inadequacy of, 749
types of, in plumbing terminology, definition of, 18
Surcharges; rate; promotion of water conservation by, 1516
Survival; equipment; experience with, committee progress report on, 1585
Symbols; graphical; standard, for use on drawings, 313

T

Take-offs; determination of, in Hardy Cross method flow analysis, 251
Tank wagons; water distribution by, 1312, 1752
Tanks; elevated; maintenance and protection of, 59, 63, 1552
solution of pressure problem by, at Madison, Wis., 601
steel; A.W.W.A. specifications for, revisions in, 1915
Tastes and odors; control of, by ammonia-induced break-point chlorination, 275
evaluation of; threshold odor method for, accuracy and application of, 877
new procedure for, 906
prevention of, by maintenance of chlorine residual, 1798
problems with, in Chicago, 1398
Temperature; effect of, on chlorine kill, 357
effect of, on residual chlorine determination, 1233
effect of, on solubility products of calcium carbonate, 1671
factors controlling changes in, in reservoirs, 720
Tennessee Valley Authority; electricity rates of, effect of, on power expense of small water works, 395
remedial measures by, to community water supplies affected by dams, 367
Threshold odor method; taste and odor evaluation by, 877, 906
Tires; *see* Automotive equipment
Toilets; effects of various types of, on rates of water consumption, 1538
Topeka, Kan.; stabilization of lime-softened water at, 1445
Transmission systems; *see* Aqueducts, Pipe
Transportation; pipe; on Los Angeles aqueduct siphons, 1637, 1659
Treasury standard; application of, to evaluation of coliform organisms in water, 581
Treatment; *see also* Purification
bottling water; chlorine in, 1040
chemical; plans for, in South District Filtration Plant, 1397
conditioning; flocculation practices in, 404
methods of, for maintenance of chlorine residuals in distribution systems, 1797
problems of, in South Dakota, 749
protective measures of, during flood emergency, at Olean, N.Y., 1750
wartime modification of, 1756
well screen; use of acid in, 691
Treatment plants; U.S.; Census data on, summary of, 1831
design and operation data on, 1847
Tuberculation; effect of metaphosphate treatment on, 1816
Tunnels; surges in, study of, in Chicago, 1406
Turbidimeter; Jackson; use of, in accelerated tests for determination of attrition loss of carbonaceous zeolites, 94
Turbidity; effect of, on chlorine kill, 358
Turbines; blades for; deposits on, problem of, 1216
steam and water; modern trends in, for pump drives, 1251

U

Underdrains; perforated-pipe; use of, for rapid sand filters, in U.S. and Canada, 857; *erratum*, 1414
United States; large rapid sand filtration plants in, design and operation data on, 1847
priorities of; application of, to Canadian firms, 831
treatment plants in, summary of Census data on, 1831
water supply practice in, 984
U.S. Geological Survey; ground water investigations of, 1597
investigation of southeastern Florida public water supplies by, 1624
study of chemical character of larger public water supplies in Georgia, 505
study of ground water in southeastern Florida by, 490
Urbana, Ill.; promoting conservation of water by rate surcharges in, 1516
water service regulations of, wartime revision of, by Illinois Commerce Commission, 1736
Utilities; Canadian; wartime procurement problems of, 829

combined administration of, benefits of, 1497
districts; organization of, at Omaha, Neb., 1505
expansion of, wartime restriction of, in Canada, 833
priorities for, *see* Priorities
public; wartime control of, 823, 1739

V

Valves; *see also* Distribution systems
check; elimination of distribution system noises by, 223
double check; safeguarding cross-connections with, 21
drawings of; graphical symbols for use on, 320
inspection and maintenance of; at Elgin, Ill., 1767
recommended practice on, during emergencies, 1890
operation of, during air raids, in wartime London, 1310
outlet; design and operation of, 1019
pumping station; modern trends in, 1255
records of; importance of, 1767, 1890
value of, during flood emergency at Olean, N.Y., 1751
Vancouver, B.C.; chlorination of water supply of, ordered by federal government, 1741
Greater Vancouver Water District; mutual aid plan of, 1588
Visitors; limitation of, as a defense measure, 470
Volunteer personnel; organization and training of, for emergency water service duties, 803

W

Wanaque project; accounting organization of, 383
War; *see also* Allocation, Priorities, Selective service
administrative problems of water works in, 546, 1189, 1508
air raids; effects of, on utility and other structures, 1328
preparedness of water works for, 20 questions on, 1340
pumping station problems in, 1689
water storage for, 969
A.W.W.A. objectives in, 979, 1295
blackouts; effectiveness of, 1329
bombing; physical effects of, 513, 1330
relative danger from and protection against, in Chicago, 1344
buildings damaged in, rebuilding of, 1294
camouflage; effectiveness of, 1330, 1666
civilian defense; British practice in, 179
Chicago plans for, for water safety control, 1343
investigations of, in Ohio, 1357
local organizations for, relation of New York State mutual aid plan to, 191
Olean, N.Y.; operation of, during flood emergency, 1743
organization and training of emergency repair crews for, 803
water supply protection in, 15, 1335
dimouts; effectiveness of, 1329
distribution system capacity increases in, by main cleaning, 1771
distribution system emergency repairs in, 1205, 1309, 1889
ground water use in, increase of, 1597, 1607, 1615
guarding; necessity for, in water supply protection, 1163, 1357
hazards; evaluation of, in Chicago, 1344
health department activities in, 1685
industrial water supply in, insuring adequacy of, by distribution system studies, 1762
mutual aid; emergency procedure under, 473
Greater Vancouver Water District, organization of, 1588
international possibilities of, 1589
Maine; operation of, 1173
Nassau County, N.Y.; initiation of, 838
New York State; operation of, 1179
organization of, 189
Olean, N.Y.; operation of, during flood emergency, 1743
Pennsylvania; operation of, 1186
plant protection in, recommended practice in, 468
quality control during, 1755
A.W.W.A. policy on, 468, 1737
federal order on, in Canada, 1739
rate problems in, 1511
sabotage; prevention of, recommended practice in, 469

protection against, in British water works, 187
relative danger from and protection against, in Chicago, 1344
salvage; importance of, 1367
supply problems in, 1362
solution of, aided by distribution system studies, 1762
valve system preparation for emergency service in, 1767, 1890
water service during; in London, 1298
revision of regulations for, by Illinois Commerce Commission, 1736
water works problems in; emphasis on, in A.W.W.A. platform for the coming year, 980
in Honolulu, T.H., 1141
War Labor Board; order and statement of, on salary increases, 1925
War Production Board; Industrial Salvage Section; work of, 1367
orders of, *see* Priorities
Waste; *see also* Conservation
elimination of, in water systems, 1295
prevention and correction of, in Pittsburgh, 1523
Water spreading; increase of ground water storage by, 1621
Water works practice; committee report on, 412
U.S.; review of, 984
Watersphere; *see* Tanks; elevated
Waukesha, Wis.; dynamiting deep wells in, 689
maximum momentary demand for domestic consumption in, 1544
Wearing rings; pump; centrifugal; maintenance of, 215, 230
Weather; relation of, to thermal changes in reservoirs, 729
Welding; drawings of; graphical symbols for use on, 326
specifications for, for Los Angeles aqueduct siphons, 1661
Wells; *see also* Ground water
capacity restoration in, with chlorine, 698
deep; development of, by dynamiting, 684
drilling of; contracts for, engineer's view of, 678
relationship between contractor for, and owner, 681
private; utilization of, for emergency supply, in wartime London, 1315
rock; development of, by agitation, 691
sanitary construction and protection of, 671
screens for, treatment of, with acid, 695
test; determining ground water capacity by, 1630
Wheeling, W.Va.; maintenance of chlorine residual in the distribution system at, 1805
Winnipeg, Man.; application of Hardy Cross method to distribution system analysis in, 247
Wisconsin; water main extension policies in, 544
Wood plugs; temporary repairs by, 1209

Z

Zeolites; carbonaceous; attrition loss of, determination of, accelerated tests for, 94

Author Index

ALDRICH, E. H., *Supervising Co-ordinator*, progress report No. 1 of the Committee on Survival and Retirement Experience With Water Works Facilities, 1585

AMSBARY, FRANK C., JR., promoting conservation of water by rate surcharges, 1516

AYRES, LOUIS E., *discussion*—development of a sound water rate structure, 374

BAILEY, W. T., *discussion*—relationship of Missouri River navigation improvements to valley properties, 487

BAITY, HERMAN G., some physical effects of bombing, 513

BARTH, JOHN, treating well screens with acid, 695

BAYLIS, JOHN R., chemical treatment plans for the South District Filtration Plant, 1397

BECKWITH, HOMER E., water waste prevention and correction in Pittsburgh, 1523

BELL, E. ARTHUR, an engineer's view of well drilling contracts, 678

BENDER, RICHARD, *see* LEVINE, MAX

BERRY, HENRY, water service in wartime London, 1298

pumping stations in the blitz, 1689

BESSON, F. S., relationship of Missouri River navigation improvements to valley properties, 475

BILLINGS, C. H., sterilization of new and repaired mains, 1777

BINGER, WALTER D., effects of air attack upon utility and other structures, 1328

BRODERICK, S. J. AND HERTZOG, E. S., accelerated tests for determination of attrition loss of carbonaceous zeolites, 94

BROWN, E. D., restoring well capacity with chlorine, 698

BROWN, H. H., wartime administrative problems in Milwaukee, 1189

BUBBIS, N. S., *see* HURST, W. D.

BUNNELL, A. E. K., wartime control of public utilities, 823

BURDICK, CHARLES B., Midwest ground water problems, 1606; *erratum*, 1784

BUSWELL, A. M., *see also* LARSON, T. E.

——— AND DUNLOP, E. C., present status of tests for organic pollution loads, 1063

BYRNE, WALTER S., the Omaha water works—a successful business, 1503

CALVERT, C. K., *discussion*—practical application of ammonia-induced break-point chlorination, 288

Chairman, progress report of Committee on Control of Chlorination, 1782

discussion—modification of the flash color test to control break-point chlorination, 1786

CAPEN, CHARLES H., *discussion*—trends in coefficients of large pressure pipes, 523, 530, 541

CARR, J. A., experiences in developing rock wells, 691

CHASE, E. SHERMAN, *Chairman*, report of Committee on Cross-Connections, 17

CLOUSER, L. H., *see* STROMQUIST, W. G.

COLE, E. SHAW, value of distribution system studies for meeting present emergencies and post-war problems, 1762

COOK, LAWRENCE H., water quality problems in small systems, 911

COSTIGAN, STELLA M., a bacteriologist looks at chlorine, 353

COX, CHARLES R., *discussion*—relation of county health department to local water supplies, 847

wartime control of water quality, 1755

CROSS, WILLIAM P. AND LOVE, S. KENNETH, ground water in southeastern Florida, 490

CULLEN, BERNARD W., *discussion*—emergency repair of distribution systems, 1210

DAPPERT, ANSELMO F., New York State mutual aid plan for water service in case of emergencies, 189
DAVIS, WALKER B., good and bad practices in tank maintenance, 1552
DECKER, A. CLINTON, comparison of estimated and actual consumption from the Birmingham industrial water supply system, 569
DEVENDORF, EARL, mutual aid plan at work in New York State, 1179
DOLAND, J. J., *discussion*—promoting conservation of water by rate surcharges, 1521
DRAKE, ALAN D. AND NEHIN, FRANK O'B., review of the Olean flood in relation to mutual aid and civilian protection programs, 1743
DUGGER, E. F., current supply problems at Newport News, 1362
DUNLOP, E. C., *see* BUSWELL, A. M.
DUNN, S. M., ridding the distribution system of pumping station noises, 221

EISENBERG, GEORGE M., isolation of an aerobic sporulating lactose-fermenting organism from Philadelphia drinking water, 385
EVERY, E. D., relationship between the well drilling contractor and the owner, 681

FABER, HARRY A., chlorine consumed tests for pollution, 746
FORD, BRUCE R. AND GUNDERSON, MILLARD F., concentrating filter for large water samples, 585
FUGATE, G. L., current supply problems at Houston, 1363
FULLER, HARRY U., guarding water works property in Portland, Me., 1168

GARRATT, J. E., *discussion*—accounting organization of the North Jersey Water District, 388
GAVETT, WESTON, *discussion*—trends in coefficients of large pressure pipes, 524
GEORGIA, F. R., evaluation of coliform organisms in water, 577
some observations on filters, 1055
GEUPEL, L. A., wartime administrative problems in Evansville, Ind., 1192
GLASS, J. R., *see* MARKS, H. C.
GOODRICH, R. D., capacity tests of ground water sources at Laramie, Wyoming, 1629
GORDON, F. G., conservation of critical materials in the design of the South District Filtration Plant, 1381
GORMAN, ARTHUR E., Chicago civilian defense plans for water safety control, 1343
GRAHAM, D. W., investigation of an unusual natural water softening, 589
GRANDY, CLAYTON, importance of salvage to the war effort, 1367
GRANT, BURTON S., *see* HURLBUT, W. W.
GREEN, STERLING S., *abstract*—U.S. water supply practice, 984
GROSS, D. D., methods of handling street excavations, 1545
GUNDERSON, MILLARD F., *see* FORD, BRUCE R.

HAGAR, MAJOR C., maintenance of chlorine residual in the distribution system, at Boonville, Mo., 1801
HALE, FRANK E., *discussion*—committee report on sodium hexametaphosphate for corrosion inhibition, 1828
HALVORSON, OTTO A., corrosion study of bolting materials and coatings, 76
HANSEN, PAUL, design of the chemical building of the South District Filtration Plant, 1390
HARDENBERGH, W. A., water supplies for the Army, 11
HARDIN, EUGENE A., *discussion*—perforated-pipe underdrains for rapid sand filters, 875
design and operation data on large rapid sand filtration plants in the U.S. and Canada, 1847
HARVILL, CLYDE R. AND MORGAN, J. H., maintenance of chlorine residual in the distribution system, at Houston, Tex., 1797
——— MORGAN, J. H. AND MAUZY, H. L., practical application of ammonia-induced break-point chlorination, 275
HATCHER, MELVIN P., water softening plant for Kansas City, 703
HAZEN, RICHARD, *discussion*—trends in coefficients of large pressure pipes, 540

HEDBERG, JOHN, *discussion*—trends in coefficients of large pressure pipes, 530
HELLER, AUSTIN, *see* LEVINE, MAX
HERBERGER, ARTHUR H., relation of county health department to local water supplies, 836
HERBERT, WILLIAM S., development of a sound water rate structure, 374
HERTZOG, E. S., *see* BRODERICK, S. J.
HOLLADAY, JOHN M., how to make a small water works self-sustaining, 390
HOOVER, CHARLES P., stabilization of lime-softened water, 1425
HOWSON, LOUIS R., *see also* WOLMAN, ABEL
repairing for defense, 793
HUGHES, GEORGE F., survey of billing and collection practices of cities of 100,000–200,000 population, 1527
HULBERT, ROBERTS, the filter backwash—sand expansion and velocity, 1045
HURLBUT, W. W., guarding water works property in Los Angeles, 1169
——— GRANT, BURTON S. AND PRICE, H. ARTHUR, steel siphon rehabilitation on the Los Angeles Aqueduct, 1635
HURST, W. D. AND BUBBIS, N. S., application of the Hardy Cross method to the analysis of a large distribution system, 247; *errata*, 463

IHLING, HERBERT, laying water mains in Milwaukee, 595
INGLEE, CLINTON, water main cleaning in the war effort, 1771

JACOBS, NATHAN B., *discussion*—rehabilitation of the Philadelphia water works, 114
JENSEN, OTTO K., relation between the water plant superintendent and the accountant, 849
JONES, GROVER, some legal aspects of sewage treatment, 53
JONES, MORRIS S., methods of financing water main extensions in California, 555
JORDAN, HARRY E., *see also* WOLMAN, ABEL
materials requirements for U.S. public water supply construction and maintenance, 737
discussion—federal order concerning water supply—Dominion of Canada, 1739

KACHMAR, JOHN F., *see* RUCHHOFT C. C.
KAPPE, STANLEY E., *discussion*—maintaining efficiency of motor-driven centrifugal pumps, 233
KELSO, A. E., U.S. water supply practice, 984
KING, K. K., wartime administrative problems in Kansas City, Mo., 1193
KLEBENOW, REINHOLD H., repairing water mains in Milwaukee, 272
KNOX, W. H., investigations of water works protection in Ohio, 1357
KRASAUSKAS, J. W., *discussion*—bacteria and chlorine, 361
KUECKER, ALVIN J., preparing the valve system for emergency service, 1767
KURANZ, A. P., meter maintenance practice, 117
discussion—development of deep wells by dynamiting, 689
studies on maximum momentary demand, 1538; *errata*, 1628

LACKEY, JAMES B., identification of micro-organisms in relation to water purification, 1559
LADUE, WENDELL R., good practice in water works management, 1483
LAMAR, WILLIAM L., chemical character of the larger public water supplies in Georgia, 505
LANGELIER, WILFRED F., *discussion*—calcium carbonate saturation index and alkalinity interpretations, 1679
——— AND LUDWIG, HARVEY F., graphical methods for indicating the mineral character of natural waters, 335
LARSON, T. E. AND BUSWELL, A. M., calcium carbonate saturation index and alkalinity interpretations, 1667, 1683
LAUTER, CARL J., the fundamentals of a properly designed and properly operating filter, 1051
LAUX, PAUL C. AND NICKEL, J. B., modification of the flash color test to control break-point chlorination, 1785
LAWRENCE, R. L., JR. AND SHARP, ALLAN R., comprehensive survey of large meters in Nashville, 121
LEARY, CHARLES J., maintenance of elevated tanks and standpipes, 63
LENHARDT, L. G., wartime administrative problems in Detroit, 1196
LEVINE, MAX, HELLER, AUSTIN AND BENDER, RICHARD, chlorine residual and bacteriological quality, 1787

LIPPERT, PAUL, *see* MCDONOUGH, FRANK J.
LISCHER, VANCE C., maintenance of centrifugal pumps, 200
LOVE, S. KENNETH, *see also* CROSS, WILLIAM P.
——— AND SWENSON, H. A., chemical character of public water supplies in southeastern Florida, 1628
LUDWIG, HARVEY F., *see also* LANGELIER, WILFRED F.
discussion—calcium carbonate saturation index and alkalinity interpretations, 1679

MACQUEEN, PHILIP O., *see* SCHMITT, EDWIN A.
MAFFITT, DALE L., sound management and the qualifications of a good superintendent, 1489
MARKS, H. C. AND GLASS, J. R., new method of determining residual chlorine, 1227
MATHEWS, EVERETT R., supply and treatment problems in South Dakota, 749
MAUZY, H. L., *see* HARVILL, CLYDE R.
MCDONALD, NORMAN G., modern trends in pumping station equipment, 1241
MCDONOUGH, FRANK J., LIPPERT, PAUL AND VEGGEBERG, JULIAN M., efficiency maintenance in Chicago pumping stations, 1405
MCHENRY, M. J., wartime procurement problems of Canadian utilities, 829
MCLAUGHLIN, M. M., accounting organization of the North Jersey Water District, 383
MCQUADE, R. A., *discussion*—maintenance of control equipment in water purification works, 242
MEDBERY, H. C., limnological observations on San Francisco reservoirs, 719
copper sulfate dispersion and settlement, 735
MEINZER, O. E., general nature of the current ground water problem, 1595
MEYERHERM, C. F., *Secretary*, progress report of American Research Committee on Grounding, 69
MILAEGER, RALPH E., development of deep wells by dynamiting, 684
MOORE, CHARLES E., an operator's monthly balance sheet, 1880
MOORE, EDWARD W., *Chairman*, report of Committee on Water Conditioning Methods to Inhibit Corrosion, 1807, 1809, 1819, 1823
——— AND SMITH, FRED E., effect of sodium hexametaphosphate on the solution of lead, 1415
MORGAN, J. H., *see* HARVILL, CLYDE R.
MORRIS, SAMUEL B., Pacific Coast ground water problems, 1615
MORSE, H. S., wartime administrative problems in Indianapolis, 1201
MURDOCH, JOHN H., JR., mutual aid plan at work in Pennsylvania, 1186

NEHIN, FRANK O'B., *see* DRAKE, ALAN D.
NEWSOM, REEVES, war and water rates, 1511
NICKEL, J. B., *see* LAUX, PAUL C.
NOBLE, RALPH E., *discussion*—evaluation of coliform organisms in water, 583

OHRT, FREDERICK, Honolulu wartime water works activity, 1141
OLSON, H. M., section of committee report on sodium hexametaphosphate for corrosion inhibition, 1821
ONGERTH, H. J., sanitary construction and protection of wells, 671

PALMER, C. E., metallizing as a method of water works maintenance, 1374
PETERSON, O. C., legal responsibility of Minnesota municipalities for polluted water, 37
PIRNIE, MALCOLM, *Chairman*, report of the Committee on Water Works Practice, 412
POTTER, HOWARD H., mutual aid plan at work in Maine, 1173
POWELL, W. CARLOS, state engineering aid to New Mexico municipalities, 56
POWELL, WILLIAM, Greater Vancouver Water District mutual aid plan, 1588
PRACY, GEORGE W., testing small meters in San Francisco, 712
PRICE, H. ARTHUR, *see* HURLBUT, W. W.

QUINN, JOHN J., section of committee report on sodium hexametaphosphate for corrosion inhibition, 1822

REBSAMEN, LLOYD M., Jonesboro's water works—a successful business, 1496
REYNOLDS, P. A., water main extension policies in Wisconsin, 544
RICE, OWEN, *discussion*—stabilization of lime-softened water, 1446
section of committee report on sodium hexametaphosphate for corrosion inhibition, 1808
RUCHHOFT, C. C. AND KACHMAR, JOHN F., study of solubility of two lead salts in dilute solutions with special reference to the lead hazard in drinking water, 85
RUPP, DANIEL H., *discussion*—stabilization of lime-softened water, 1445

SCHMITT, EDWIN A. AND MACQUEEN, PHILIP O., perforated-pipe underdrains for rapid sand filters, 857; *erratum* 1414
SCHUERHOLZ, L. V., maintaining efficiency of motor-driven centrifugal pumps, 229
SCHWARTZ, M. C., critical problems in the boiler feed water field, 1214
SCOTT, R. D., addendum to modification of the fluoride determination, 522
SCOTT, WARREN J., guarding water works property in Connecticut, 1163
SEDGWICK, R. M., cost accounting for water utilities, 564
SHARP, ALLAN R., *see* LAWRENCE, R. L., JR.
SMITH, E. E., substitute and alternate materials for service pipe, 1042
SMITH, FRED E., *see* MOORE, EDWARD W.
SMITH, L. A., Madison's new watersphere, 601
SMITH, MARSDEN C., current supply problems at Richmond, 1364
section of committee report on sodium hexametaphosphate for corrosion inhibition, 1824
SPAULDING, CHARLES H., accuracy and application of threshold odor tests, 877
STEARNS, H. F., maintenance and protection of elevated water tanks, 59
STEWART, A. H., health departments in wartime, 1685
STOCKWELL, H. P., JR., section of committee report on sodium hexametaphosphate for corrosion inhibition, 1812
STROMQUIST, W. G. AND CLOUSER, L. H., relation of river dams to community water supplies, 367
SWENSON, H. A., *see* LOVE, S. KENNETH

TARBETT, RALPH E., water supply protection in civilian defense, 1335
TAYLOR, D. R., organization and management, 1
THOMAS, FRANK B., how the examiner looks at the water works, 1533
THOMAS, HAROLD A., JR., bacterial densities from fermentation tube tests, 572
THWAITS, E. H., section of committee report on sodium hexametaphosphate for corrosion inhibition, 1810
TODD, ARTHUR R., maintenance of chlorine residual in the distribution system, at Wheeling, W.Va., 1805
TOLMAN, SAMUEL L., water conditioning by flocculation, 404

VAN LOAN, SETH M., rehabilitation of the Philadelphia water works, 107
VEGGEBERG, JULIAN M., *see* MCDONOUGH, FRANK J.

WARREN, H. S., *Chairman*, progress report of American Research Committee on Grounding, 69
WEIBEL, S. R., summary of Census data on water treatment plants in the United States, 1831
WEIR, W. VICTOR, emergency repair of distribution systems, 1205
WELLS, BERT, traveling laboratory control of bottlers' operation, 1035
WHITAKER, M. B., problems and limitations in the installation of water main extensions to suburban areas, 561
WILDSMITH, A. CARRINGTON, wartime water works maintenance in Britain, 179
WILSON, P. D., growing pains of a small town water system, 402
WOLMAN, ABEL, a platform for the A.W.W.A. in the coming year, 979
——— HOWSON, LOUIS R. AND JORDAN, HARRY E., 1942 A.W.W.A. objectives, 1295
WOOD, ALAN A., maintenance of control equipment in water purification works, 237

Index of Abstract Topic Headings

Accounting and Financing, 446
Administration, Personnel and Public Relations, 442, 1267
Algae Control, 765
Apparatus, *see* Laboratory Methods
Aqueducts, *see* Tunnels

Bacteriology, 618, 1466
Boiler Feed Water, 309

Canadian Water Supplies—General, 302
Chemical Feeding, Conditioning and Sedimentation, 943
Chemistry, 629, 1455
Concrete, 1124
Conditioning, *see* Chemical Feeding
Conservation and Irrigation, 150, 1580
Construction, *see* Distribution Systems
Corrosion and Corrosion Control, 458, 937
Cross-Connections and Plumbing, 612

Dams, 158, 1122
Defense, 130, 288, 431; *see also* Wartime Water Works Problems
Distribution Systems—Construction and Maintenance, 1111, 1708

Feed Water, *see* Boiler Feed Water
Filtration, 775
Financing, *see* Accounting
Fire Protection, 606
Foreign Water Supplies—General, 305

Ground Water, *see* Wells

Health and Hygiene, 141, 449, 1279
Hydraulics, 155, 1471
Hydrology, 150, 1476
Hygiene, *see* Health

Impounding Reservoirs, 760
Industrial Water Supply, 294
Iron Removal, *see* Softening
Irrigation, *see* Conservation

Laboratory Methods—Equipment and Apparatus, 615
Law, Litigation and Liabilities, 1272

Maintenance, *see* Distribution Systems
Meters, 1117

Odor Control, *see* Taste and Odor Control

Personnel, *see* Administration
Plumbing, *see* Cross-Connections
Pollution, *see* Stream Pollution
Public Relations, *see* Administration
Pumps and Pumping, 1107

Quality, 770

Reservoirs, *see* Impounding Reservoirs

Sedimentation, *see* Chemical Feeding
Softening and Iron Removal, 777
Sterilization, 136
Stream Pollution and Its Control, 954, 1574, 1697
Swimming Pools, 147

Taste and Odor Control, 768
Treatment—General, 772
Tunnels and Aqueducts, 1118

U.S. Water Supplies—General, 297

Wartime Water Works Problems, 756, 1102, 1261, 1569, 1692; *see also* Defense
Wells and Ground Water, 947, 1703

Abstract Subjects

All page numbers in boldface type in this index are the first pages of topic sections as noted in the "Index of Abstract Topic Headings," or of numerous abstracts on the particular subject.

A

Absorption; capacity of resins for, 634
properties of, of bituminous coatings, 1712
Accidents: *see* Hazards
Accounting; **446**
wartime problems in, 1107
Acid; β-resorcylic; use of, as colorimetric reagent for ferric iron, 1458
perchloric; oxidation by, application of, to organic phosphorus in lakes, 1462
treatment with, increase of well flow by, 1705
Activated sludge; purification mechanism of, 630
Administration; **442, 1287**
Adsorbents; exchange; synthetic resins as, 633
Adsorption; soluble silica; from water, 637
Aerobacter; see Coliform bacteria
Africa; South; water supply improvements in, delay of, by lack of materials, 308
water management in, 151
Agar; *see* Media
Agriculture; Department of, *see* U.S.
water for, *see* Irrigation
Air; T.N.T. in, determination of, 133
Air chambers; effect of, in centrifugal pumps, 1108
Air raids; *see also* Bombing, Defense, Wartime water works problems
precautions for, as related to building design, 756
shelters for, British policy and practice on, 288, 289
water supply during, 757
Airports; drainage of, concrete pipe for, 1124
Algae; control of, **765**
production of, in Wisconsin lakes, 763
Algicides; *see* Algae; control of
Allocations; comparison of, with priorities, 293
Alloys; non-ferrous; testing of, for condenser tube service, 461
Alpine Dam; enlargement of, 1123
Alum; *see* Aluminum sulfate
Aluminate; sodium; production and use of, 1463
Aluminum; bronze; corrosion pitting of, influence of stress on, 460, 940
effect of water on, 461
Aluminum sulfate; electric dose-meter for, 944
emergency specifications for, 1267
Amebic dysentery; *see* Disease
Ammonia; determination of, in water, 1458
Ammonia-nitrogen; relation of, to breakpoint chlorination, 138
Ammonium formate; use of, in separation of bismuth from lead, 638
Analysis; arsenic; methods of, in foods contaminated by war gases, 132, 133
bacteriological; **618, 1466**
of swimming pools, **147**
chemical; **629, 1455**
application of, to B.O.D. determination, 956
of swimming pools, **147**
laboratory; methods, apparatus and equipment for, **615**
water; reporting results of, 771
Ankara, Turkey; reservoir water supply of, 763
sanitation of water supply at, 140
Annual reports; Baghdad, Iraq, 308
Brantford, Ont., 304
Brockville, Ont., 305

Dorval, Que., 305
Erie, Pa., 300
London, Ont., 305
Ottawa, Ont., 305
Timmins, Ont., 305
Antagonistic micro-organisms; study of, 620
Antimony; dezincification prevention by, 941
Apparatus; laboratory, **615**
Appropriation; water; for beneficial use, Kansas law on, 1276
Aqueducts; **1118**
Arizona; ground water for irrigation in, 154
Army; infectious diseases in, during wartime, 130
sanitation in the field for, 1264
utilities expansion for, in El Paso, Tex., 1696
water supply for, 1263
Army camps; municipal problems raised by, 440
sewage plant design for, bases of, 759
site selection for, 440
water demands and sewage production in, 1103
water supply for, assured by underground storage, 951
Arsenic; determination of, in foods contaminated by war gases, 132, 133
dezincification prevention by, 941
gases of, *see* Gases
ingestion and excretion of, in man, 143
reduction of, in waste waters, 1701
removal of, from water, 641
Artesian water; chief types of, in Hungarian plain, 949
increasing supply of, by tunnels, at Honolulu, 1706
occurrence of, in coastal area of Georgia and northeastern Florida, 949
suitability of, as geological indicator in Hungarian plain, 949
Artesian wells; air-lift for, 949
Asphalt; coating steel pipe with, 1115
reservoir construction with, 160
Atlanta, Ga.; filter plant at, modernization and enlargement of, 777
Australian National Research Council; work of, 760
Automotive equipment; conservation of, by municipal departments, 431
Auxiliary supplies; *see* Supplies

B

Bacteria; **618, 1466**
coli-like; characteristics of, isolated from chlorinated water supply, 628
disease-producing; micro-organisms antagonistic to, found in soil, 146
effect of chlorination on, in sewage, 138
increase of, in distribution systems, causes of, 772
spore-forming lactose-fermenting; isolation of, from Lexington, Ky., water supply, 629
use of, as instrument of warfare, 1692
Bactericides; action of, effect of vacuum on, 622
chlorinating waters as, during their self-purification, 1471
hypochlorite solutions; efficiency of, factors affecting, 136
oligodynamic silver; efficiency of, factors controlling, 623
Bacteriology; **618, 1466**
Bacteriophages; presence of, in soil, 629
use of, as index of water contamination, 1471
Baghdad, Iraq; annual report of water board of, 308
Baltimore, Md.; high-rate trickling filters at, experiments with, 776
sewage effluent of, sale of, for industrial water supply to steel plant, 294
tunnel construction at, 1119
water demands exceed safe supply limits at, 300
Barranquilla, Colombia; water supply developments in, 306
Base-exchange; *see also* Zeolites
concentration of dilute solutions of electrolytes by, 635
fluoride removal by, 1463
occurrence of, in salty ground waters of Atlantic and Gulf coasts, 1703
properties of synthetic resins for, 633, 634
softening by, economical method of, 781
treatment by, theory and practice of, 777
Bentonite; purification with, 772
treatment with, properties of floc in, 945

Berlin, Germany; ground water situation in, history of, 1707
Bethlehem Steel Co.; industrial water supply of, from Baltimore sewage effluent, 294
Biochemical oxygen demand; determination of; application and interpretation of, 639
chemical method for, 956
long-time; study of, at low temperatures, 1698
sulfite waste liquor, effects of dilution water on, 957
Bismuth; separation of, from lead, with ammonium formate, 638
Bitumen; surfacing treatment of water supply catchment by, 760
Blackouts; opinions of electric industry on, 434
Boilers; **309**; *see also* Steam
steam; cross-connections to, 613
Bombing; *see also* Air raids, Defense, Wartime water works problems
damage by, proneness of industrial plants to, 1569, 1570
effect of, on buildings and utilities, 292
protection of water supply and sewerage systems against, 1571
removal of damaged pipe after, 1265, 1711
Bombs; incendiary; Japanese; specifications of, 1693
Bottling industry; emergency drinking water source offered by, 441
Boutron and Boudet method; determination of hardness by, irregularities in, in waters containing strontium salts, 633
Brantford, Ont.; annual report of water works of, 304
Brass; alloys of, dezincification resistance of, tests of, 461
pipe; relation of, to health, 1285
Break-point chlorination; *see* Chlorination
Breathing; prevention of, in steel siphons, by thicker pipe metal, 1119
Brewing industry; water supplies for, treatment of, 295
Bridges; pier construction for, complication of, by ground water supply, 1706
Brilliant green bile broth; *see* Media
Brine systems; *see* Cooling systems
Bristol, England; water service repair methods in, after air raids, 433
Britain; *see* Great Britain
Brockville, Ont.; annual report of water works of, 305
Bromocresol green; use of, for indication of carbonates in water, 635
Bronze; aluminum; corrosion pitting of, influence of stress on, 460, 940
corrosion of, in Corinth, 941
Brucellosis; epidemic of, from *Brucella melitensis*, 457
Buffalo, N.Y.; cross-connection control in, 613
Broth; *see* Media
Buenos Aires; investigation of bacteria of *Salmonella* group in sewage of, 1469
Buildings; *see also* Housing
bombed; static water tanks in basements of, for fire protection water, 756
design of, relation of, to air raid precautions, 756
effects of bombs on, in Britain, 292
gas explosions in, cause and prevention of, 611
Buret; separating; design of, 616
Butter; quality of, relation of water supply to, 296

C

Calcium carbonate; *see* Carbonates
Cambridge, Mass.; elementary school; children's story of water supply used in, 446
Camden, N.J.; rehabilitation of old wells at, 950
Camps; army, *see* Army camps
Canada; administration of water works systems in, 444
Committee on Bacteriological Examination of Water and Sewage, report of, 1471
fire protection charges in, 610
hydrant maintenance costs in, 610
Ontario; cross-connection control in, 612
deep well supplies in, 1707
water works of, centralized laboratory service for, 617

Saskatchewan; sanitation practices in, 145
water supplies of, improvements and construction in, **297**
Canals; flow in; essentials of good formula for, 1475
irrigation; conveyance losses in, 154
Canneries; vegetable; wastes of, treatment of, 1700
Cantonments; *see* Army camps
Carbazide; diphenyl; colorimetric determination of lead by, 637
Carbon dioxide; detection of, from mixtures of carbonates and sulfites, 1462
Carbonaceous zeolites; *see* Zeolites
Carbonates; bromocresol green-methyl red indicator for, 635
calcium; saturation balance of, continuous indicator of, 459
determination of, rapid procedure for, 636
feed water conditioning with, limitations on, imposed by carbonate-sulfate-hydroxyl balance, 310
mixtures of, with sulfites; detection of carbon dioxide and sulfur dioxide in, 1462
Caries; *see* Disease
Cascades; Indiana State Soldiers and Sailors Monument; calcareous incrustation on, 463
Cases; court; *see* Legal decisions
Casings; gas-well; cathodic protection of, 940
Cast iron; mechanical properties of, effect of corrosion on, 460
research on, 1113
Catchment basins; *see* Reservoirs, impounding
Cathodic protection; **938**
Cation-exchange; *see* Base-exchange
Cavitation; *see also* Corrosion
occurrence of, in outlet conduits of high dams, 159
Cellulose derivative; use of, as substitute for agar, 619
Cement; **1124**; *see also* Concrete
lining with, *see* Linings
Censorship; organization of Advisory Committee on Scientific Publications for, 760
Centrifugal pumps; air chambers in flow through, 1108
visual experimentation with, 1107
Ceramic industry; water supplies for, treatment of, 296
Chemical feeding; **943**
chlorinators; mobile; for emergency use, 757
new type patented, 947
for copper sulfate, 944
Chemical plants; fire prevention and fire fighting in, 610
Chemicals; floc-forming; survey of, 944
handling of, fire prevention techniques in, 610
poisoning of water supplies by, 1106
priorities in, 135
Chemistry, **629 1455**
ground water, 948
saliva, relationship of, to dental caries, 142
Chemists; professional status of, 1271
Chicago, Ill.; blackout practice in, 436
Chloride; ferric; use of, as permanent standard in colorimetric estimation of nitrate, 1459
sodium; solutions of, corrosion of 18-8 stainless steel in, 460
Chlorinating water; bactericidal effect of, during self-purification, 1471
Chlorination; *see also* Sterilization
break-point; relation of ammonia-nitrogen to, 138
de-; effect of, on swimming pool waters, 148
effect of, on bacteria in sewage, 138
on virus of poliomyelitis, 142
emergency; measures for, 140
methods of, at Rochester, N.Y., to combat pollution of water supply, 458
wartime water supply treatment by, 133
modern methods of, in New Toronto, Ont., purification plant, 140
sterilization by, in the Philippines, 138
super-; taste and odor control by, 769
wartime practices of, in Bristol, England, 434
Chlorinators; *see* Chemical feeding
Chlorine; absorption of, 1471
content of, in water, automatic control of, 1465
determination of, residues from, recovery of silver nitrate from, 1464

Froboese number; significance of, in determination of organic substances, 632
gas; intoxication by, 140
production of, from salt and sulfur, 639
residual; relation of, to water bacteriology, 622
solubility of, in water, 640
well rejuvenation by, 1704
Chlorophyll; content of, in Wisconsin lakes, 463
Chromium plating; wastes of, disposal of, 1577
Circulation; ground water; differential density a factor in, 1704
Citrate-utilization; value of, for differentiating between *Esch.* and *Aer.* genera, 625
City manager; survey of position and functions of, 443, 1267
Civil defense; *see* Defense, Wartime water works problems
Coagulation; water treatment by, 946
Coal; carbonaceous zeolites from 780, 781
storage of, considerations in, 1573
mine; ground water supply from, 949
Coatings; *see also* Linings
asphalt; use of, on steel pipe, 1115
bituminous; permeability and absorption properties of, 1712
Cochin-China; control of drinking water in, 629
Coefficients; discharge; theoretical; for a weir of ogee profile, 156
elimination of, from surface runoff determinations, 1478
fluid-friction, 1473
V-notch weir; viscosity and surface tension effects on, 1473
Cofferdams; pumps for, capacity increased in, 1110
Coli-aerogenes; *see* Coliform bacteria
Coliform bacteria; *Aerobacter;* differentiation of, and *Escherichia*, value of citrate-utilization for, 625
Aer. aerogenes; incidence and significance of, 1469
isolation of, from soil, 627
determination of; brilliant green bile broth for, 1467
efficiency of various media for, 1467
with violet red bile agar, 626
differentiation between *Esch.* and *Aer.* genera, value of citrate-utilization for, 625
Eijkman relationships of, 1468
Escherichia; differentiation of, and *Aerobacter*, value of citrate-utilization for, 625
Esch. coli; dehydrogenases of, effect of potassium tellurite on, 1470
determination of, accelerated method of, by membrane filters, 625
disinfectant action of phenol on, 624
Esch. coli mutabile; papillae-forming strains of, anaerogenic derivatives of, 627
group of, serological relation of, to genus *Salmonella*, 1469
growth of, in distilled water, 626
incidence of, on fresh vegetables, 1467
origin of, in human intestine, 626
pectin-fermenting; sanitary significance of, in water, 627
pollution by, degree of, significance of differences in, 1468
presumptive tests for, comparison of in sea water and shellfish, 625
Collars; wood-stave; main repair with, 1712
Colloids; boiler; feed water treatment by, 311
Communications; system of, during air raids, in Bristol, England, 433
telephone; cable; effects of bombing on, 293
Composition; drinking water; change of, on storage, 763
Compounds; boiler; feed water treatment by, 311
Concrete; **1124**; *see also* Cement
elevated tank construction with, 1116
prestressed; tank construction with, 1117
reinforced; pressure filter construction with, 775
Condensates; central heating system; degassing of, 462
Condensers; cathodic protection of, 940
oil refinery; corrosion of, 462
tubes; corrosion of, 461, 941
non-ferrous alloys for, testing of 461
Conditioning; **943**

carbonate; feed water; limitations on, imposed by carbonate-sulfate-hydroxyl balance, 310
contribution of, to steam generation, 310
co-ordination of, with power plant operating problems, 310
phosphates in, 782
Conductivity tests; degasification of steam samples for, 312
Conduits; *see also* Aqueducts, Mains, Pipe
high-pressure; pipe connections for, 1118
outlet; high-dam; cavitation in, 159
Connections; pipe; types of, for high-pressure conduits, 1118
Conservation; **150, 1580**
automotive equipment; recommended practice in, for municipal departments, 431
distribution system equipment; methods of, 1711
ground water; need for, 947
tin; in wipe and joint solders, 1711
Construction; bridge pier; complication of, by ground water supply, 1706
Canadian water supply, **302**
dam; **158, 1122**
distribution system, **1111, 1708**
foreign water supply, **305**
reservoir; asphalt in, 160
U.S. water supply, **297**
Consumption; water; data on, in military cantonments, 1103
Consumptive use; application of, to water for agriculture, 154, 1584
Contact; corrosion of metals by, 460
Contamination; *see also* Pollution, Sterilization
air; by T.N.T., 133
bacteriophage as an index of, 1471
covered reservoir; methods of combating, 139
hot-water; in copper cylinders, 143
metallic; of hot water, from cylinders of bare and tinned copper, 1284
putrefaction capacity in, estimation of, by potassium ferricyanide consumption, 631
toxic; types of, in drinking water, 1284
Contracts; defense; types and operations of, 442
Control; automatic; of chlorine content in water, 1465
bacteriological, 624, 629
feed water; methods of, in a paper mill, 309
ground water; practical precautions in, 1705
sanitary; survey of, in U.S., 297
stream pollution; **954, 1574, 1697**
Controls; *see also* Meters
installation and maintenance of, 1110
pump; efficiency promotion by, 1111
Cooling systems; brine; scale and corrosion control in, 942
cathodic protection of, 940
scale and corrosion studies in, 463
sodium pentachlorophenate treatment of, 296, 766
Copper; alloys of; corrosion tests on, in oil refineries, 461
bare and tinned; cylinders of, metallic contamination of hot water from, 1284
corrosion of, 461
cylinders; contamination of hot water in, 143, 1284
determination of small amounts of, in water and sewage, 637
effect of, on algae, 765
estimation of, in water, 1456
pipe; relation of, to health, 1285
Copper sulfate; aerotreatment of reservoirs with, 765
feeder for, 944
maintenance of proper concentration of, in water treatment, 765
poisoning of fish by, 765
Corinth, Greece; specimens of corroded bronze at, 941
Corn cobs; purification with, 773
Corrosion; control of; **458, 937**
combination of, with zeolite water softening, 781
treatment of domestic supply for, 772
Court decisions; *see* Legal decisions
Cross-connections; **612**
pollution of water supply through, at Rochester, N.Y., 458
Cultivation; effect of, on runoff and erosion from Muskingum silt loam, 1583
Culture environment; effect of, on results with dilution method of determining bacterial population, 622

Culture media; *see* Media
Cumberland River; plankton population of, effect of Nashville, Tenn., sewage on, 1699
Current; *see* Electricity
Currents; corrosion; causes of, 459
Curvature; effects of, in supercritical flow, 156
Cylinders; copper; contamination of hot water from, 143, 1284
Cyprus; water supply of, 306

D

Damage proneness number; application of, to industrial plants, 1569, 1570
Dams; design, construction and maintenance of, **158, 1122**
Death rate; Mexican; monthly variations in, 1280
Debris; removal of, from reservoirs, 764
De-chlorination; effect of, on swimming pool waters, 148
Defense; **130, 288, 431, 756, 1102, 1261, 1569, 1692**
  contracts; types and operations of, 442
  emergency chlorination practices in, 140
  emergency supply for fire fighting in, 609
  housing for, plumbing systems for, 614
  industrial emergency in, depreciation problem in, 446
  inter-municipal co-operation in, fire fighting for, 606
  main sterilization practice in, 139
  wartime problems of industrial sales, 442
Degasification; *see also* Gases
  methods of, for condensates of central heating systems, 462
Dehydrogenases; *Esch. coli;* effect of potassium tellurite on, 1470
Delaware Aqueduct; passing faults in, 1120
  reservoir and dams of, 1122
  tunnel lining on, 1120, 1121
Delaware River; pollution of, analytical study of, 1698
Demand; water; data on, in military cantonments, 1103
Density; differential; factor of, in circulation, oxidation and ore deposition by ground water, 1704
Dental caries; *see* Disease
Dental fluorosis; *see* Disease
Denver, Colo.; extensions to water system of, 300
Department of Agriculture; water facilities program of, 150
Depreciation; problem of, during war crisis, 446
  water works equipment; survey of, 448
Depth; water; measurement of, portable electric gage for, 153
Depth sampler; design of, 616
Detergents; evaluation of, methods for, laboratory studies of, 616
Dezincification; *see* Zinc
Diarrhea; *see* Disease
Diatoms; development of, limitation of, with silicon and phosphorus, 766
Diesels; *see* Power
Dilution test; modification of, 1466
Dilution water; effects of, on B.O.D. of sulfite waste liquors, 957
Diphenyl carbazide; colorimetric determination of lead by, 637
Discharge; coefficients of; theoretical; for a weir of ogee profile, 156
Discs; meter; plastics for, 1118
Disease; *see also* Health
  bacteria causing, soil as a source of micro-organisms antagonistic to, 146
  bacterial; spreading of, as instrument of warfare, 1692
  dental caries; association of, in school children, with water hardness, 1283
    human; effect of topically applied fluorine on, 1283
    induction of, in rats, 1283
    relation of domestic water to, 1282
    relation of fluorine intake to, 142
    relation of oral *Lactobacillus acidophilus* and saliva chemistry to, 142
    research on, by Mellon Institute, 617
  dental fluorosis; factors in the etiology of mottled enamel in, 1283
    threshold; condition suggestive of, observed in Tristan da Cunha, 1283

diarrheal; acute; studies of, 1280
dysentery; amebic; carriers of, problem of, 141
bacillus of, isolation of new species of, 1470
gastro-enteritis; causes, incidence and inhibition of, 141
epidemic of, in Rochester, N.Y., from pollution through cross-connection, 458
relation of public water supplies to, 1281
goiter; endemic; etiology of, relation of fluorine to, 142
infectious; wartime occurrence of, 130
intestinal; incidence of *Aer. aerogenes* in feces of cases of, 1469
outbreaks of, from water, milk and other foods in 1939, summary of, 457
paratyphoid; outbreak of, in North Battleford, Sask., 1282
types A and B; single dose immunization against, with alum-precipitated T.A.B. vaccine, 1282
poliomyelitis; virus of, effect of chlorination on, 142
principal causes of death in Mexican states, 1280
schistosome dermatitis; control of, in swimming places, 148
typhoid; carriers of; court decision re, 1277
treatment of, sulfaguanidine noneffective in, 1282
cases of, at Rochester, N.Y., resulting from pollution of drinking water through cross-connection, 458
single dose immunization against, with alum-precipitated T.A.B. vaccine, 1282
summary of, in large cities of U.S., 449
treatment of; sulfaguanidine noneffective in, 1282
Disinfection tests; stabilized spore suspension for, 620
Disposal; sewage; relation of, to water purity, in Toronto, 1703
water; planning techniques for, 1581
Dissolved oxygen; *see* Oxygen
Distilleries; wastes of, stream pollution by, 1578
Distribution systems; bacterial increase in, causes of, 772
building; *see* Plumbing
construction of, **1111, 1708**
extensions to, court decision enforcing, 1277
maintenance of; **1111, 1708**
during air raids, in Bristol, England, 433
Dithizone system; photoelectric colorimetric technique for, 637
Diversion; water; for beneficial use, Kansas law on, 1276
Divining; water; electrical basis for, 1704
Dorval, Que.; annual report of water works of, 305
Dowsing; electrical basis for, 1704
Drainage; airport; concrete pipes for, 1124
analysis of, for water-disposal planning, 1581
Drinking water; emergency sources of, offered by bottling plants, 441
Dye; gentian violet; no further certification of, 620
stains; progress in standardization of, 620
Dysentery; *see* Disease

E

Earthquakes; protection of elevated tanks against, 1116
East Bay Municipal Utility District; emergency maintenance methods of, 298
Eberthella typhosa; isolation of, new culture medium for, 618
Economy; wartime; in water works operation, 1261
Education; elementary school; children's story of water supply used in, 446
El Paso, Tex.; utilities expansion in, for army use, 1696
Electricity; *see also* Power
current; requirement of, for cathodic protection systems, determination of, 939
thawing of frozen pipes by, 113, 1714
Electrodes; dropping-mercury; dissolved oxygen recordings with, 1465
Electrolytes; dilute solutions of, concentration of, by base-exchange materials, 635

Embankments; earth; time required for saturation of, 158
Embrittlement; detection of, in boilers, 311
Employees; *see* Personnel
Endo medium; *see* Media
Energy; loss of, at base of free overfall, 1471
Engineering; sanitary and public health; advisory board on, defense work of, 440
protective and remedial measures of, 1262
Engineers; approach to fluid mechanics by, 1475
sanitary; need for, in health departments, 144
professional status of, 1279
England; *see* Great Britain
Enteric bacteria; selective action of eosin methylene blue agar on, 618
Eosin methylene blue agar; *see* Media
Equipment; distribution system; conservation of, methods of, 1711
laboratory, **615**
water works; obsolescence of, 448
Erie, Pa.; annual report of bureau of water of, 300
Erosion; control of, for reservoir protection, 152
effect of mulching and methods of cultivation on, from Muskingum silt loam, 1583
regional contrasts in, relation of, to regional contrasts in torrential rainfalls, 1583
Escherichia; see Coliform bacteria
Evaporation; relation of, to use of water for agriculture, 154
Evaporation-loss; from land areas, 1476
Everett, Wash.; improvements to water supply system at, 301
Exchange; *see* Base-exchange
Expenditures; municipal; control of, accounting methods for, 447
Explosions; gas; cause and prevention of, in buildings, 611
Extensions; distribution system; court decision enforcing, 1277

F

Farms; water system construction for, 1708
water systems for, aid in wartime increase in food production, 757
Federal Power Commission; reduction of gas rates by, upheld by Supreme Court, 1278
Federal standard; *see* Standards; quality
Feed water; **309**
phosphates in, convenient colorimetric test for, 1461
Feeders; *see* Chemical feeding
Ferricyanide; potassium; consumption of, by contaminated water, estimation of putrefaction capacity by, 631
Ferrobacteria; *see* Iron bacteria
Film; liquid; formation of, criticism of balanced-layer theory of, 635
Filters; **775**
membrane; accelerated method of *Esch. coli* determination by, 625
Filtration; **775**
Financing; **446**
public utility; impact of war upon, 1106
Fire protection; **606**
auxiliary supplies for, in wartime Britain, 437
emergency supplies for, 134, 437, 756
use of cement in, 1125
water for, stored in static tanks in basements of bomb-damaged buildings, 756
Fish; poisoning of, by copper sulfate and rotenone, 765
toxicity of sodium pentachlorophenate and pentachlorophenol to, 1699
Fittings; *see* Pipe
Floc; formation of, chemicals for, 944
properties of, in purification with bentonite, 945
Floods; control of, **151, 1582**
hazards of, reduction of, by reservoir system, 1583
routing of; direct method of, 1477
simplified method of, 157
Florida; northeastern, artesian water in, 949
Flow; *see also* Hydraulics
analysis of; Hardy Cross Method; application of, to multiple reservoirs, 1476
balancing pipe head losses by, chart for, 1476
effluent trough; quantitative evaluation of, 156
flood; computation of, in streams, by slope-area method, 151

fluid; through centrifugal pumps, 1108
ground water; effect of forests on, 950
pattern of, 947
metering of; *see* Meters
open-channel; four régimes of, 155
velocity distribution in, 155
pipe-network; direct determination of, 1475
river and canal; essentials of good formula for, 1475
supercritical; effects of curvature on, 156
well; increase of, by acid treatment, 1705
Flue gas; tannery waste treatment with, 1579
Fluids; mechanics of, engineer's approach to, 1475
Flumes; concrete; repairing of, without interrupting service, 1121
Venturi; flowmetering by, 1473
Fluorides; removal of; from public water supplies, 1463
from water, by ionic exchange, 1463
Fluorine; assimilation of, from minerals and food, 1464
determination of; in water, 642, 643
photocolorimetric method for, 643
dietary; determination of, 1462
ingestion of, relation of, to dental caries, 142
occurrence and effect of, on human saliva, 1282
relationship of, to etiology of endemic goiter, 142
removal of, from water, 641
topical application of, effect of, on human caries, 1283
Fluorosis; *see* Disease
Foods; arsenic in, determination of, 132, 133
disease outbreaks from, in 1939, summary of, 457
fluorine assimilation from, 1464
production of, increase of, aided by farm water systems, 757
quality of, effect of water quality on, 771
Forests; effect of, on ground water flow, 950
Formate ricinoleate broth; *see* Media
Freezing; *see also* Thawing
prevention of; in submarine mains, by electric preheating, 1114
in rotary meters, 1119
Friction; fluid; problems of, graphical solution of, 1473
pipe; *see also* Hydraulics
measurement of, relation of Reynolds number to Manning's n in, 157
Froboese chlorine number; significance of, in determination of organic substances, 632
Frost; *see* Freezing, Thawing

G

Gages; electric; portable; measuring water depth with, 153
recording; mechanical; measuring water level with, 153
rainfall; design of, for remote mountain station, 1482
optical; measurement of dam tilting with, 160
water level; design of, for cold weather service, 1714
Gases; chlorine; intoxication by, 140
degasification; methods of, for condensates of central heating systems, 462
dissolved; removal of, from boiler feed water, 312
explosion of, in buildings, cause and prevention of, 611
flue; tannery waste treatment with, 1579
war; contamination of food by, 132, 133
Lewisite; food contamination by, 133
mustard; detection of, new apparatus for, 133
T.N.T.; determination of, in air, 133
water pollution by, 1574
welding; hazards of, 143
Gastro-enteritis; *see* Disease
Gentian violet; no further certification of, 620
Geology; ground water, 948
Georgia; coastal area of, artesian water in, 949
Germicides; *see* Bactericides
Glasses; drinking; cleansing of, methods of, 616
Goiter; *see* Disease
Government; federal; participation of, in stream pollution control, 1576

water policies of, relation of unusual events to, 1580
regulation by, effect of, on utility operation, 1271
state; structure of, distribution of health services in, 1279
Grand Forks, N.D.; two sources of supply at, 301
Grand Rapids, Mich.; new pipeline for, 1120
Grand River, Ont.; conservation policy for, 1581
sewage dilution problem of, 1579
Graphs; solution of fluid-friction problems by, 1473
Great Britain; ground water supply in, 951
health in, during wartime, 131
Ground water; **947, 1703**; *see also* Wells
conservation policy for, in Ohio, 1581
use of, for irrigation in Arizona, 154
Grouting; tunnel lining; procedure of, on Delaware Aqueduct, 1121
Gunite; prestressed; elevated tank construction with, 1716
repair of concrete by, 1124

H

Hardness; *see also* Softening
association of caries in school children with, 1283
chemical aspects of, 778
determination of; Boutron and Boudet method of; irregularities in, in waters containing strontium salts, 633
Hardy Cross Method; application of, to multiple reservoirs, 1476
balancing pipe head losses by, chart for, 1476
Hazards; chemical; fire prevention and fire fighting techniques for combating of, 610
chlorine gas; experience with, 140
flood; reduction of, by reservoir system, 1583
gas explosion; cause and prevention of, in buildings, 611
health; *see* Health
welding; control of, 1710
effects of gases and fumes in, 143
Head loss; pipe; balancing of, by Hardy Cross Method, chart for, 1476
Health; **141, 449, 1279**; *see also* Disease, Sanitation
effect of war on, in Britain, 131
effect of water purification on, in U.S., 297
federal wartime policies in, 1694, 1695
modern laws and regulations on, validity of, 1276
relation of swimming pool sanitation to, **147**
safeguarding of, by control of cross-connections, **612**
Health departments; need for sanitary engineers in, 144
responsibilities of, in wartime, 1103
Health officials; conference of, on wartime tasks, 1104
Heating systems; central; condensates of, degassing of, 462
Hiwassee Dam; design of, basic considerations of, 158
Holland; *see* Netherlands
Honolulu, T.H.; artesian supply of, increase of, by tunnels, 1706
Hospitals; plumbing practice in, 614
Hot-water systems; contamination in, by copper, 143, 1284
scale formation prevention in, 943
water for, 462
Housing; defense and low-cost; plumbing systems for, 614
Hungary; artesian water in, 949
Hydrants; maintenance of, costs of, in Canada, 610
rental of; schedules for, 609, 610
Hydraulics; **155, 1471**
pump, 1108
Hydrobiology; symposium on, 768
Hydrogen ion concentration; *see* pH
Hydrology; **150, 1476**
Hygiene; **141, 449, 1279**
swimming pool, **147**
Hypochlorite; solutions of, germicidal efficiency of, factors affecting, 136

I

Illinois; water supplies of, sanitation of, survey of, 145
Immunization; single-dose; alum-precipitated T.A.B. vaccine for, against typhoid and paratyphoid A and B, 1282
Impounding reservoirs; *see* Reservoirs

Improvements; Canadian water supply, **302**
foreign water supply, **305**
U.S. water supply, **297**
Incrustation; calcareous; formation of, on cascades of Indiana State Soldiers and Sailors Monument, 463
Indianapolis, Ind.; State Soldiers and Sailors Monument at, calcareous incrustation on cascades of, 463
Indicators; bromocresol green-methyl red; use of, for carbonates in water, 635
Indole; estimation of, photoelectric method for, 1470
Industrial wastes; *see* Wastes
Industrial water supply; **294**
Industry; defense; increase of stream pollution by, 135
plants; proneness of, to damage, through enemy action, 1569, 1570
powder; water for, in the South, 1572
stream pollution by, **954, 1574, 1697**
Infantile paralysis; *see* Disease, poliomyelitis
Infiltration; studies of, in Pecos River watershed, 1706
Inflation; effect of, on public utilities, 1270
Ingestion; fluorine; relation of, to dental caries, 142
lead and arsenic, effect of, 143
Inorganic substances; reporting of, 632
Intakes; deep; construction and installation of, at Muskegon Heights, Mich., 301
extension of, at Port Credit, Ont., 304
Inter-connections; use of, for emergency supplies in wartime, 134
Intestinal coli; *see* Coliform bacteria
Intestine; human; origin of *Esch. coli* in, 626
Ion-exchange; *see* Base-exchange
Iron; cast-; mechanical properties of, effect of corrosion on, 460
research on, 1113
determination of; colorimetric; electrolytic iron as standard for, 1458
Kojic acid method of, 638
thiocyanate method of, 638
electrolytic; use of, as standard for colorimetric determination of iron, 1458
estimation of, in water, 1455
ferric; β-resorcylic acid as colorimetric reagent for, 1458
removal of; **777**
reinforced concrete pressure filters for, 775
Iron bacteria; classification, identification and control of, 628
rôle of, in formation of ferrous deposits, 629
Irrigation; **150, 1580**

J

Japan; incendiary bombs used by, specifications of, 1693
Joints; pipe thread; use of wicking in, 1112
solders for; use of less tin in, 1711
Joliet, Ill.; sandstone water supplies of, 1706

K

Kansas; laws of, application of, to diversion and appropriation of water to beneficial use, 1276
Kentucky Utilities Co.; public service commission order to, re rates, 1278
Key West; fresh water aqueduct for, 1121
Kojic acid; use of, in colorimetric determination of iron, 638

L

Laboratory equipment and apparatus; **615**
priorities regulations on, 1266
Laboratory methods; **615**
Lactobacillus acidophilus; oral; relation of, to dental caries, 142
Lactose broth; *see* Media
Lake Erie; limnological studies of, 767
Lakes; *see also* Reservoirs; impounding
fresh-water; sediments of, 762
organic matter cycle in, relation of aquatic bacteria to, 1471
organic phosphorus in, perchloric acid oxidation of, 1462
sediments of, oxidation-reduction potentials and pH of, 762
Laundries; wastes of, chemical treatment of, 1701
Law; **1272**; *see also* Legal decisions
application of, to water pollution, 957

Lead: colorimetric determination of, by diphenyl carbazide, 637
ingestion and excretion of, in man, 143
microanalysis of, rapid method for, 637
priorities in, 136
separation of bismuth from, with ammonium formate, 638
welding of, 1710
Legal decisions; **1272**
sewage treatment; operation of plant for, not enjoined, in Texas, 146
Lewisite; *see* Gases, war
Lexington, Ky.; isolation of spore-forming lactose-fermenting organism from water supply of, 629
Liabilities; **1272**
Libya; deserts of, ground water in, 954
Lime; properties and commercial application of, 943
tannery waste treatment with, 1579
Lime-soda; feed water treatment with, 309
Limnology; investigations of, on Texas reservoir lakes, 763
studies of, in western Lake Erie, 767
Linings; *see also* Coatings
cement; in-place installation of, for capacity increase, 1114
use of, on cast-iron pipe, 1713
tunnel; procedure employed, on Delaward Aqueduct, 1120, 1121
Litigation; **1272**
Logs; removal of, from reservoirs, 764
London, England; tube wells in, 954
London, Ont.; annual report of public utilities commission of, 305
Long Island, N.Y.; effect of warm water recharge on ground water temperature on, 948
Longueuil, Que.; water supply problems at, 303
Los Angeles; Building and Safety Department of, work measurement in, 444
governmental cost accounting in, 447

M

Madras, India; slow sand filters at, chemistry and biology of, 777
Maine; state plumbing code in, 614
Mains; *see also* Distribution systems, Pipe
coating of, *see* Coatings
collecting; laying of, in filtered water reservoir, 773
corrosion of, **458, 937**
emergency sterilization of, 1266
laying of, under tidal creek, 1715
lining of, *see* Linings
repair of, with wood-stave collars, 1712
small; sterilization of, 139
steel; small; repair of, 1112
submarine; prevention of freezing in, by electrical preheating, 1114
Maintenance; aqueduct; 1120, 1121
concrete; methods of, 1124
dam, **158**
distribution system, **1111, 1708**
methods of, during air raids, in Bristol, England, 433
emergency methods of, in East Bay Municipal Utility District, 298
hydrant; costs of, in Canada, 610
main; sterilization after, 139
meter; **1117**
motors and controls; methods of, 1110
well; methods of, 950
Management; *see also* Administration
ground water; practical precautions in, 1705
water; in Africa, 151
Manganese; intoxication by, in well water, 1287
presence of, in deep reservoirs, 763
Manning's *n*; relation of, to Reynolds number, 157
Manpower; *see* Personnel
Marin Municipal Water District; enlargement of Alpine Dam for, 1123
Masonry; dam construction with, 1122
Materials; corrosion-resistant; ferrous and non-ferrous, study of, 937
priorities in, *see* Priorities
Meaford, Ont.; pumphouse floor lowered at, 304
Mechanics; fluid; engineer's approach to, 1475
Media; agar; cellulose derivative substitute for, 619
reclamation of, 620, 1466, 1467
silica gel as substitute for, 619
brilliant green bile broth; determination of coliform group in water with, 1467
2 per cent; efficiency of, for determination of coliform group, 1467

culture; new type of, for isolating *Eberthella typhosa*, 618
Eijkman; coliform bacteria relationships investigated with, 1468
Endo; replacement of, with rosolic medium, 619
eosin methylene blue agar; selective action of, on enteric group, 618
formate ricinoleate broth; efficiency of, for determination of coliform group, 1467
lactose broth; efficiency of, for determination of coliform group, 1467
nutrient; new type of, for bacteria with special requirements, 619
papain digest; use of, 618
rosolic; replacement of Endo medium by, 619
selective bacteriostatic effect of slow oxidizing agents, 620
standardization of, 618
tetrathionate agar; preparation of, factors influencing, 618
violet red bile agar; determination of coliform organisms with, 626
Mellon Institute; researches of, during 1940–41, 617
Membrane filters; accelerated method of *Esch. coli* determination by, 625
Mercuric oxide; use of, in Nessler's reagent, lowers expense of, 632
Metals; conservation of, water softener aids in, 759
contact corrosion of, 460
estimation of, in water, 1455
mechanical properties of, effect of corrosion on, 460
monel; corrosion pitting of, influence of stress on, 460, 940
priorities in, *see* Priorities
solder; *see* Solders
surface protection of, 940
Meters; **1117,** *see also* Controls
flow; Venturi flume type of, 1473
new plastic parts for, research on, by Mellon Institute, 617
Methyl red-bromocresol green indicators; use of, for carbonates in water, 635
Mexico; monthly variations in death rate and principal causes of mortality in, 1280
Miami, Fla.; purchase of private company distribution system by, 299
Microbiological deposits; effect of, on corrosion control in water circuits, 942
Microcystis aeruginosa; permanent bloom of, in Temple tank, ecology of, 766
Micro-organisms; antagonistic relations of, 620
soil as a source of, antagonistic to disease-producing bacteria, 146
Milk; disease outbreaks from, in 1939, summary of, 457
Milk industry; wastes of, action of, on cement products, 1125
Minerals; content of, reduction of, with organic zeolites, 779
fluorine assimilation from, 1464
non-metallic; water softening with, 782
Minneapolis; water softening at, 784
Minnesota; water conservation policy of, 1581
Monel metal; corrosion pitting of, influence of stress on, 460, 940
Monongahela River; steel plant water supply from, 294
Mont Laurier, Que.; replacement of pipeline at, 1715
Mortar; consistency of, measurement of, vibrators for, 1124
Mosquitoes; breeding of, possibilities of, in static water supplies, 1287
Most probable number; accuracy and standard error of, 1466
Motors; installation and maintenance of, 1110
Mottled enamel; *see* Disease; fluorosis
Muds; pond; experiments with, 764
Mulching; effect of, on runoff and erosion from Muskingum silt loam, 1583
Municipalities; cost accounting methods in, 447
large; U.S.; typhoid in, summary of, 449
problems of, raised by army camps, 440
small; expenditure accounting for, 447
Muskegon Heights, Mich.; new intake at, 301
Mustard gas; *see* Gases, war
Mutual aid; inter-municipal; application of, to fire fighting, 606

N

Naracoote, S. Australia; town water supply installation at, 1707
Nashville, Tenn.; sewage of, effect of, on

plankton population of Cumberland River, 1699
Neisseria catarrhalis; indication of swimming pool pollution by, 147
Nessler reagent; use of mercuric oxide in, lowers expense of, 632
Nessler solution; decomposition of, 632
new stabilizing agent for, application of, to determination of urea nitrogen in biological fluids, 1459
Netherlands; standardization of pipes in, 1113
New Britain, Conn.; new steel filtration plant at, 776
New England; river pollution in, control plans for, 1574
New Toronto, Ont.; modernized chlorination at, 140
New York City; Delaware system of; water treatment for, 773
water supply system of, survey of real estate of, 1271
New York Worlds Fair; site of, swimming pool built in lake at, 149
Nitrate; determination of; colorimetric method for, with β-methyl-umbelliferone, 1460
estimation of; colorimetric methods for, 1459
colorimetric method for, ferric chloride as permanent standard in, 1459
silver; recovery of, from residue of chlorine determination, 1464
sterilization of swimming pool waters with, 148
Nitrites; determination of, 1459
Nitrogen; ammonia; relation of, to break-point chlorination, 138
determination of, qualitative method for, 1459
urea; determination of, in biological fluids, application of new stabilizing agent for Nesslerized solutions to, 1459
Norfolk, Va.; defense activities in, 441
North Battleford, Sask.; paratyphoid fever outbreak at, 1282
North Dakota; Supreme Court of, utility rate decision by, 1278
Nutrient media; *see* Media
Nyasaland Protectorate; water supply investigation in, 308
water supply works in, 1707

O

Obsolescence; water works equipment; survey of, 448
Occupational hazards; *see* Hazards
Odor control; **768**
Ohio; cross-connection control in, 612
surface and underground waters of, 1581
Oil; determination of, in small quantities, 1465
measurement of, in boiler feed water, 312
Oil refineries; condensing equipment of, corrosion of, 462
corrosion tests on copper alloys in, 461
Ontario; *see* Canada
Open channels; *see* Flow
Operation; instruction of enlisted men in, 1264
wartime economy in, 1261
Operators; *see* Personnel
Ores; deposition of, by ground water, differential density a factor in, 1704
tungsten in, determination of, 1458
Organic substances; cycle of, in lakes, relation of aquatic bacteria to, 1471
determination of, significance of Froboese chlorine number in, 632
Orillia, Ont.; progressive development of water system at, 304
Ottawa, Ont.; annual report of water works of, 305
Overfall; free; energy loss at base of, 1471
Overflow; law of, 1275
Overturning; observations on, in reservoirs of San Diego County, 762
Ownership; utility, analysis of, 448
Oxidation; catalytic; atmospheric oxygen for, in sulfite waste liquor, 1701
ground water; differential density a factor in, 1704
perchloric acid; application of, to organic phosphorus in lakes, 1462
Oxidation-reduction potentials; data on, of lake waters and sediments, 762
Oxygen; atmospheric; catalytic oxidation of sulfite waste liquor by, 1701
determination of content of, in aqueous solutions, simple colorimetric micromethod for, 638

dissolved; determination of, application and interpretation of, 639
determination of, Winkler method for, sulfamic acid modification of, 639
quantitative determination of, 639
recording of, with dropping mercury electrode, 1465
Oxygen saturation; degree of, calculation of, slide rule for, 616
Ozone; purification by, 770
taste and odor control by, 769

P

Papain digest media; *see* Media
Paper industry; biological treatment of sulfate-mill waste by, 958
feed water control in, 309
water supplies for, treatment of, 295
Paralysis; infantile; *see* Disease, poliomyelitis
Paratyphoid; *see* Disease
Particle size; determination of, by sedimentation, 615
Pecos River, N.M. and Tex.; watershed of, infiltration studies on, 1706
Pectin; fermentation of, by coliform bacteria in water, sanitary significance of, 627
Pensions; Social Security Act; recent Treasury proposals on, 445
Pentachlorophenate; sodium; toxicity of, to fish, 1699
treatment of cooling water with, 296, 766
Pentachlorophenol; sodium; toxicity of, to fish, 1699
Permeability; properties of, of bituminous coatings, 1712
Personnel; **442, 1267**
defense training for, 134
industrial; drinking water sanitation for, 1288
occupational hazards to, *see* Hazards
scientific; full utilization of, in war effort, 1267
wartime production of, 1694
use of enlisted men for army water supply operators, 1264
Personnel relations; defense measures in, 438
Patapsco River, Md.; effects of industrial pollution in lower portion of, 1576
Petroleum industry; water pollution abatement problems of, 958
pH; application of, to water treatment, 774
data on, of lake waters and sediments, 762
observations on, in reservoirs of San Diego County, 762
Phenols; by-product; recovery of, 1701
determination of, in water, 635
disinfectant action of, on *Esch. coli*, 624
photocolorimetric determination of, in aqueous solutions, 635
Phenoloids; plant; estimation of, by Fox and Gauge method, 770
Philadelphia, Pa.; rehabilitation of water system of, 298
Philippines; sterilization by chlorination in, 138
Phosphates; determination of; colorimetric method for, in boiler water, 1461
V. Lorenz procedure for, 1460
recent developments in, 1463
water conditioning with, 782
Phosphorus; limiting diatom development with, 766
organic; perchloric acid oxidation of, in lake waters, 1462
value of, in preventing dezincification, 941
Photometer; photoelectric; modification of, for colorimetric determinations, 616
Pickle liquor; utilization of, research on, 617
Pipe; bomb-damaged; removal of, 1265
brass; relation of, to health, 1285
cast-iron; cement-mortar lining of, in place, 1713
cathodic protection of, 1941 status of, 938
cleaning of, without interrupting service, 1114
coating of; *see* Coatings
concrete; airport drainage by, 1124
placing of, into difficult position, 1121
connections; types of, for high-pressure conduits, 1118
copper; corrosion of, 461
relation of, to health, 1285
damaged; removal of, after bombing 1265, 1711

effects of bombing on, 293
farm water system, 1708
fittings for; welded; comparison of, with miter and intersection welding, 1112
friction in; measurement of, relation of Reynolds number to Manning's *n* in, 157
frozen; thawing of, by electricity, 1113, 1714
head loss in, balancing of, by Hardy Cross Method, chart for, 1476
industrial process; corrosion control in, 942
lining of; *see* Linings
networks of, flow in, by direct determination, 1475
plumbing; **614**
replacement of, at Mont Laurier, Que., 1715
standardization of, in the Netherlands, 1113
thread joints; use of wicking in, 1112
underground; cleaning of, methods of, 1114
welding of, 1111, 1708
wood; wartime use of, 1711
Pitting; aluminum-bronze; influence of stress on, 940
experience with, in 12-inch gate valves, 463
influence of stress on, in aluminum-bronze and monel metal in water, 460, 940
Plankton; *see also* Algae
effect of Nashville, Tenn., sewage on, in Cumberland River, 1699
significance of, in relation to sanitary condition of streams, 1699
Plastics; use of, in water meter discs, 1118
Plumbing; **614**
Pneu pump; description of, 1109
Poisoning; chemical; danger of, to water supplies, 1106
manganese; from well water, 1287
water pollution by, 1574
Poliomyelitis; *see* Disease
Pollution; *see also* Contamination, Sterilization
control of, by waste pickle liquor utilization, research on, 617
degree of, by coliform bacteria, significance of differences in, 1468
drinking water; study of, at Rochester, N.Y., 458
ground water; practical precautions against, 1705
poisons and gases as agents of, 1574
stream, **954, 1574, 1697**
control of; requirement of sewage treatment for, by stream control commission upheld in Michigan, 146
increase of, by defense production, 135
swimming pool; *Neisseria catarrhalis* as an index of, 147
Ponds; muds of, experiments with, 764
Population; bacterial; dilution method of determining, effect of culture environment on, 622
effect of volatile solvents on, in sewage, 623
increase of, in distribution systems, causes of, 772
Port Credit, Ont.; extension of water works intake for, 304
Portions; size of, for federal quality standard, 624
Potassium; ferricyanide; consumption of, by contaminated water, estimation of putrefaction capacity by, 631
tellurite; effect of, on dehydrogenases of *Esch. coli*, 1470
Potentials; oxidation-reduction; data on, of lake waters and sediments, 762
Potomac River; pollution control in, 1577
Power; *see also* Electricity, Steam
auxiliary sources of, for defense, 438
provision of, at Turlock, Calif., 301
electric; cables; effects of bombing on, 293
industry's opinion on blackouts, 434
preheating water by, for preventing submarine mains from freezing, 1114
thawing of frozen pipes by, 1113, 1714
production of, methods of increasing, 759
steam; generation of, contribution of water conditioning to, 310
operating problems in, co-ordination of water conditioning with, 310

Precipitators; double-cone; water softening by, at Minneapolis, 784
Spaulding; conditioning with, 945
Priorities; application of, to laboratory equipment, 1266
comparison of, with allocations, 293
in chemicals, 135
in lead, 136
manufacture of pumps and water systems encouraged under, 757
problems of, 1573
Property; water works; protection of, against bombing and sabotage, 1102
Public relations; **442, 1267**
Publications; scientific; censorship of, 760
Pumping; **1107**
plant for, wartime expansion of, 1696
Pumps; **1107**
air-lift; use of, in artesian wells, 949
lowering of, for better suction, 304
priorities on, encourages volume water system sales, 757
trailer; use of, in Britain, after air raids, 293
Purification; *see also* Treatment
bentonite; properties of floc in, 945
mechanism of activated sludge in, 630
natural; study of in Scioto River, 1697
ozone for, 770
self-; effect of temperature on, 623
of chlorinating water, bactericidal effects during, 1471
synthetic resin ion-exchange; operating characteristics of, 634
technological and economic results of, 297
Putrefaction capacity; estimation of, of contaminated water, by potassium ferricyanide consumption, 631
Pyrogens; emergency removal of, from drinking water, 144

Q

Quality; **770**
bacteriological; control of, in Cochin-China, 629
control methods; survey of, in U.S., 297
relation of sewage disposal to, in Toronto, 1703
standards of; federal; revision of, 771
size of portions in, 624

R

Rainfall; frequency determinations of; station-year; reliability of, 1481
recording gage for, design of, for remote mountain station, 1482
runoff prediction from, method of, 1480
surface runoff determinations from, without using coefficients, 1478
torrential; regional contrasts in, relation of, to regional contrasts in erosion, 1583
Ranney system; underground storage by, 951
Rates; fire protection; schedules for, 609, 610
gas; reduction of; Federal Power Commission upheld in, by Supreme Court decision, 1278
utility; North Dakota Supreme Court decision on, 1278
public service commission order on, in Kentucky, 1278
Reagents; colorimetric; β-resorcylic acid; ferric iron detection by, 1458
organic; special reference to, in estimation of metals in water, 1455
Nessler's; use of mercuric oxide in, lowers expense of, 632
Real estate; survey of, of New York City water supply system, 1271
Refineries; oil; condensing equipment of, corrosion of, 462
corrosion tests on copper alloys in, 461
Regulation; government; *see* Government
Repair; *see* Maintenance
Reports; annual; importance of, 445
Research; effect of war on, 1573
organization of, for wartime efficiency, in Australia, 760
relation of, to defense, 439
Reservoirs; algae control in, **765**
construction of, with asphalt, 160
covered; contamination of, 139
filtered water; installation of, at Windsor, Ont., 1715
laying large collecting mains in, 773
flood control; Tygart; operating experiences in, 1583
impounding, **760**; *see also* Lakes
use of, on Delaware Aqueduct, 1122

multiple; flow from, analysis of, by Hardy Cross Method, 1476
multi-purpose operation of, 152
protection of, by erosion control, 152
system of, flood hazards reduced by, 1583
welded steel; design of, 1716
Residual chlorine; relation of, to water bacteriology, 622
Resins; synthetic; ion-exchange properties of, 633
water purification by, operating characteristics in, 634
water absorption by, 634
Resources; *see also* Supplies
water; conservation of, 151
summary of, for Transjordan, 150
Reynolds number; relation of, to Manning's *n*, 157
Riparian rights; selected problems in, in the West, 1272
Rivers; *see* Streams
Rochester, N.Y.; water supply of, pollution of, through a cross-connection, 458
Roma, Tex.; new storage tank installed at, 301
Rome, Italy; water supply of, 306
Rosolic medium; *see* Media
Rotenone; poisoning of fish by, 765
Rotifera; vertical distribution of, in Douglas Lake, Mich., 766
Runoff; effect of mulching and methods of cultivation on, from Muskingum silt loam, 1583
prediction of, from rainfall, method of, 1480
surface; determinations of, from rainfall, without using coefficients, 1478
Rural areas; open-air swimming pools for, in Germany, 149

S

Sabotage; measures against, 437, 1102, 1106, 1574, 1692
Safety; *see* Hazards
St. Lawrence River; waterway development project on, probable improvements to water and sewerage systems to river towns as a result of, 303
St. Paul, Minn.; economical water softening system at, 783
Sales; industrial; new problems in, raised by war, 442
Salisbury, S. Rhodesia; water supply of, 308
Saliva; chemistry of, relationship of, to dental caries, 142
occurrence and effect of fluorine on, 1282
Salmonella; investigation of, in Buenos Aires sewage, 1469
serological relation of group of coliform bacilli to, 1469
Salt; solutions of, corrosion of 18–8 stainless steel in, 460
use of, with sulfur, in production of chlorine and salt cake, 639
Salt cake; production of, from salt and sulfur, 639
Salts; occurrence of, in irrigation water, 1584
strontium; irregularities in results of hardness determination by Boutron and Boudet method in waters containing, 633
Samples; bacteriological; size of, for federal quality standard, 624
depth; apparatus for, 616
oxygen saturation of, slide rule for calculation of, 616
systematic and random, precision of estimates from, 615
San Felipe, Argentina; buttress dam at, 1123
San Luis Obispo County, Calif.; defense activities in, 440
Sand; *see also* Filtration
removal of, from well water, 1704
Sandstone; wells in, in Joliet, Ill., area, 1706
Sanitary engineering; *see* Engineering
Sanitation; *see also* Health, Sterilization
activities of state agencies in, 1279
drinking water, for industrial personnel, 1288
methods of, in the field, for the U.S. Army, 1264
practices in, in Saskatchewan, 145
survey of, of Illinois water supplies, 145
swimming pool; **147**
wartime activities in, in Southeast, 1104
Saskatchewan; *see* Canada

Saturation; calcium carbonate; continuous indicator of, 459
oxygen; degree of, calculation of, slide rule for, 616
Scalby, England; new water supply for, 306
Scale; control of, in water and brine systems, 942
formation of; in cooling systems, 463
in water heaters, prevention of, 943
silica; effect of, in boiler feed water, 311, 312
Scarborough, Ont.; improvements to water system of, 303
Schistosome dermatitis; *see* Disease
Science; relation of, to defense, 439, 1267, 1694
Scioto River; pollution and natural purification in, 1697
Screens; well; cleaning of, 950
Sea water; presumptive tests for coliform bacteria in, 625
Sedimentation; **943**
particle size determination by, 615
Sediments; *see also* Silt
occurrence of, in fresh-water lakes, 762
Self-purification; effect of temperature on, 623
of chlorinating water, bactericidal effects during, 1471
Service; maintenance of; during pipe cleaning, 1114
during repairs to cracked concrete flume, 1121
Services; *see* Pipe
Sewage; bacteria in; effect of chlorination on, 138
effect of volatile solvents on, 623
Salmonella group; investigation of, at Buenos Aires, 1469
dilution of, in relation to pollution, in Grand River, Ont., 1579
disposal of, relation of, to water purity in Toronto, 1703
effect of, on plankton population, 1699
effluent; use of, for industrial water supply, 294
plants; design of, bases of, for army cantonments, 759
1941 program of construction of, 956
production of, in military cantonments, 1103
raw; settleable solids in, 1702
treatment of; operation of plant for, not enjoined in Texas, 146
plant design for, problems of, in wartime boomtowns, 1103
requirement of, by stream control commission upheld in Michigan, 146
Sewers; cleaning of, methods of, 1114
effects of bombing on, 293
Shellfish; presumptive tests for coliform bacteria in, 625
Shelters; air raid; British policy and practice on, 288, 289
Silica; gel; use of, as substitute for agar, 619
scale; effect of, in boiler feed water, 311, 312
soluble; adsorption of, from water, 637
determination of, in water, 636
Silicon; limiting diatom development with, 766
Silt; *see also* Sediments
deposition of, measurement of, upstream of dams, 761
removal of, from reservoirs, by sluicing, 762
Silting; reservoir; reduction of, by erosion control, 152
Silver; oligodynamic; germicidal activity of, factors controlling, 623
Silver nitrate; recovery of, from residue of chlorine determination, 1464
sterilization of swimming pool waters with, 148
Siphons; steel; "breathing" in, stopped by thicker pipe metal, 1119
Skin; schistosome dermatitis infection of, control of, in swimming places, 148
staphylococcal infections of, relation of calcium soaps to, 143
Slide rule; design of, for calculating degree of oxygen saturation in water samples, 616
Sludge; activated; purification mechanism of, 630
Slucing; silt removal by, in reservoirs, 762
Soaps; calcium; relation of, to staphylococcal infections in skin, 143
Social Security Act; recent Treasury proposals on, 445
Soda; bleaching; water softening with, 782

Soda-lime; feed water treatment with, 309
Sodium; determination of; rapid; in waters and soil extracts, 1458
Sodium aluminate; production and use of, 1463
Sodium chloride; solutions of, corrosion of 18-8 stainless steel in, 460
Sodium pentachlorophenate; toxicity of, to fish, 1699
treatment of cooling water with, 296, 766
Sodium pentachlorophenol; toxicity of, to fish, 1699
Sodium pyrophosphate; tetra-; properties of, 1464
water softening with, 782
Sodium thiosulfate; anhydrous; use of, as primary standard, 632
Soft-drink industry; emergency drinking water source offered by, 441
Softening; **777,** *see also* Hardness
use of, as an aid in metal conservation, 759
Soil; bacteriophages in, 629
cathodic protection in, 939
corrosion by, ferrous and non-ferrous materials resistant to, 937
extracts; sodium in, rapid determination of, 1458
isolation of coliform bacteria in, 627
micro-organisms antagonistic to disease-producing bacteria found in, 146
Muskingum silt loam; effect of mulching and methods of cultivation on runoff and erosion from, 1583
Solders; substitute; trial of, prompted by tin shortage, 758
wipe and joint; use of less tin in, 1711
Solids; settleable; occurrence of, in raw sewage, 1702
Solutions; Nessler's; decomposition of, 632
new stabilizing agent for, application of, to determination of urea nitrogen in biological fluids, 1459
Solvents; volatile; effect of, on bacterial numbers in sewage, 623
South Africa; water supply improvements in, delay of, by lack of materials, 308
Spaulding precipitators; conditioning with, 945
Spillways; bellmouth; laboratory experiments on, 159
Spore suspension; stabilized; for disinfection tests, 620
Springfield, Mass.; ground water survey at, 950
Springfield, Mo.; new water works at, 299
Stagnation; observations on, in reservoirs of San Diego County, 762
Stains; gentian violet dye; no further certification of, 620
progress in standardization of, 620
Standards; chemical; primary; anhydrous sodium thiosulfate as, 632
plumbing; codes for, 614
quality; federal; revision of, 771
size of portions in, 624
Standpipes; *see also* Distribution systems, Tanks
steel; design of, for Tulsa, Okla., 1116
Staphylococci; skin infection by, relation of calcium soaps to, 143
Steam; *see also* Power
generation of, contribution of water conditioning to, 310
samples of, degasification of, for conductivity tests, 312
steel corrosion by, at high temperature, 460
trickling; turbine blade corrosion by, 942
use of, in large pumping plant, 1109
Steel; *see also* Pipe, Mains, Tanks
cathodic protection of, in corrosive solutions, 939
corrosion of, by steam, at high temperature, 460
stainless; 18-8; corrosion of, in NaCl solutions, 460
Steel industry; water supply of, from Baltimore sewage effluent, 294
water supply of, from Monongahela River, 294
Sterilization; **136;** *see also* Chlorination
dry; studies in, 1287
emergency; methods of, in water mains, 1266
swimming pool; **147**
Storage; *see also* Reservoirs, Standpipes, Tanks
emergency drinking water; types of, 1265

underground; army camp supply assured by, 951
Ranney system of, 951
Streams; flood-flows in, computation of, by slope-area method, 151
flow in, essentials of good formula for, 1475
measurement of, science of, 1476
multi-purpose reservoir projects on, 152
pollution of, *see* Pollution
sanitary condition of, plankton significance in relation to, 1699
Stress; influence of, on corrosion pitting of aluminum-bronze and monel metal in water, 460, 940
Strontium salts; waters containing, irregularities in results of Boutron and Boudet hardness tests in, 633
Structures; vibration periods of, 1713
Sulfaguanidine; failure of, in treatment of typhoid and typhoid carriers, 1282
Sulfamic acid; use of, in modification of Winkler method for dissolved oxygen, 639
Sulfate; copper; *see* Copper sulfate
Sulfate mills; wastes of, biological treatment of, 958
Sulfate of alumina; *see* Aluminum sulfate
Sulfate reduction; occurrence of, in salty ground waters of Atlantic and Gulf coasts, 1703
Sulfates; determination of, turbidimetric method for, rapid, 1461
Sulfite waste liquor; B.O.D. of, effects of dilution water on, 957
catalytic oxidation of, by atmospheric oxygen, 1701
Sulfites; mixtures of, with carbonates, detection of carbon dioxide and sulfur dioxide in, 1462
Sulfur; use of, with salt, in production of chlorine and salt cake, 639
Sulfur dioxide; solubility of, in water, 640
steam-contained; turbine blade corrosion by, 942
Super-chlorination; *see* Chlorination
Supplies; auxiliary; provision of, for fire fighting in wartime Britain, 437
Canadian; improvements and construction in, **302**
drinking water; emergency source of, offered by bottling plants, 441
emergency; provision of, for fire fighting, 609
fire protection; static tanks for, in basements of bomb-damaged buildings, 756
foreign; improvements and construction in, **305**
ground water; **947, 1703**
industrial; **294**
inter-connection of, as a defense measure, 134
problems of, 1573
problems of, in post-war period, 1697
provision of, during air raids, 757
surface and underground, in Ohio, 1581
U.S.; improvements and construction in, **297**
wartime; emergency chlorination of, 133
Surface tension; effects of, on V-notch weir coefficients, 1473
study of, of Wisconsin lakes, 763
Surfacing; bituminous; treatment of water supply catchment by, 760
Swimmer's itch; *see* Disease; schistosome dermatitis
Swimming pools; **147**

T

Tanganyika Territory; water supplies in, 1707
Tanks; *see also* Distribution systems, Standpipes
cathodic protection of, experiences with, 939, 940
drinking water; internal protection of, with clear varnish, 940
elevated; concrete; design features of, 1116
moving of, by railroad, 297
prestressed gunite for, 1716
protection of, against earthquake damage, 1116
vibration periods of, 1713
welded; exterior ribs in, 1116
new types of, for emergency fire supplies, 134
static; construction of, for fire protection water, in basements of bomb-damaged buildings, 756
mosquito breeding possibilities of, 1287
storage; prestressed concrete in, 1117

Tanneries; wastes of, treatment of, with flue gas and lime, 1579
Tape measure; match-box holder for, 1716
Taste and odor control; **768**
Telephone cables; effects of bombing on, 293
Temperature; effect of, on capacities of base-exchange materials, 780
effect of, on self-purification of water, 623
ground water; effect of recharge of warm water on, on Long Island, 948
high; corrosion of steel by steam at, 460
low; long-time biochemical oxygen demands at, 1698
observations on, in reservoirs of San Diego County, 762
Tennessee Valley Authority; work of, on industrial waste pollution, 957
Tetrasodium pyrophosphate; properties of, 1464
water softening with, 782
Tetrathionate agar; *see* Media
Texas; reservoir lakes of, limnology of, 763
state health department of; quality rating system of, 771
waters of, pollution of, 1579
Thawing; *see also* Freezing
electric method of, for frozen pipes, 1113, 1714
Thiocyanate; ferric; determination of iron with, 638
reaction of, 638
Thiosulfate; sodium; anhydrous; use of, as primary standard, 632
Tilting; dam; measurement of, with optical device, 160
Timmins, Ont.; annual report of water works of, 305
Tin; reduction of, in wipe and joint solders, 1711
shortage of, demands trial of substitute solders, 758
Tires; conservation of, by municipal departments, 431
Topping industry; feed water treatment in, 310
Toronto, Ont.; new purification plant at, 773
relation of sewage disposal and water purity in, 1703
swimming facilities in, control of, 149
treatment of water supply for, history of, 303
water works laboratories of, 617
Transjordan; water resources of, 150
Transpiration; relation of, to use of water for agriculture, 154
Treasury standard; *see* Standards; quality
Treatment; **772,** *see also* Purification
acid; increase of well flow by, 1705
algae control, **765**
biological; use of, for sulfate-mill wastes, 958
boiler feed water, **309**
coagulation; survey of, in Brazil, 946
industrial waste, **1700**
industrial water supply, **294**
well water, 1704
Trinidad; water supply program at, 305
T.N.T. gas; determination of, in air, 133
Tristan da Cunha; condition suggestive of threshold dental fluorosis observed in, 1283
Troughs; effluent; flow in, 156
Tube wells; use of, in London, Eng., 954
Tubes; condenser; corrosion of, 461, 941
non-ferrous alloys for, testing of, 461
Tulsa, Okla.; design of large steel standpipe for, 1116
Tungsten; determination of, in ores, 1458
Tunnels; **1118**
increase of artesian supply by, at Honolulu, 1706
Turbines; adaptability of, in pumping stations, 1109
blades of; corrosion of, by trickling steam and steam containing sulfur dioxide, 942
Turlock, Calif.; remodeling of water supply system at, 301
Tygart Reservoir, Pa.; operating experiences in, 1583
Typhoid; *see* Disease

U

U.S.; Department of Agriculture; water facilities program of, 150
Federal Power Commission; reduction of gas rates by, upheld by Supreme Court, 1278

improvements and construction in water supplies of, **297**
large cities of, typhoid in, summary of, 449
Public Health Service; wartime policies and activities of, 1694, 1695
Treasury Department; recent proposals of, on Social Security Act, 445
water quality standards; *see* Standards; quality
War Production Board orders; *see* Priorities
Urban areas; open-air swimming pools for, in Germany, 149
Urea nitrogen; determination of, in biological fluids, application of new stabilizing agent for Nesslerized solutions to, 1459
Utilities; effects of bombing on, 293
effects of government regulation on, 1271
effects of inflation on, 1270
expansion of, for army use, in El Paso, Tex., 1696
ownership of, analysis of, 448
systems of, relative value of, 445

V

Vaccine; T.A.B.; alum-precipitated; single-dose immunization with, against typhoid and paratyphoid A and B, 1282
Vacuum; effect of, on destruction of bacteria by germicides, 622
Valves; *see also* Distribution systems
gate; 12-inch; severe case of pitting in, 463
installation and maintenance of, 1115
operation of, under emergency conditions, 1102
Vanadium; determination of, in water, 642
removal of, from water, 641
Varnish; clear; internal protection of drinking water tanks with, 940
Velocity; distribution of, in open channels, 155
Vibration; characteristics of, of structures, 1713
Vibrators; application of, for measuring mortar consistency and fabricating mortar cubes, 1124
Violet red bile agar; *see* Media
Viscosity; effects of, on V-notch weir coefficients, 1473

W

War Production Board orders; *see* Priorities
Wartime water works problems; **130, 288, 431, 756, 1102, 1261, 1569, 1692**
Washington; state water supply defense plans of, 756
Wastes; arsenious; purification of, 1701
chromium plating; disposal of, 1577
distillery; stream pollution by, 1578
industrial; stream pollution problems from, 955, 958
treatment of, recent contributions to study of, 1700
laundry; chemical treatment of, 1701
milk industry; action of, on cement products, 1125
pickle liquor; utilization of, research on, 617
sulfite liquor; B.O.D. of, effects of dilution water on, 957
catalytic oxidation of, by atmospheric oxygen, 1701
sulfate-mill; biological treatment of, 958
tannery; treatment of, with flue gas and lime, 1579
vegetable cannery; treatment of, 1700
Water depth; measurement of, portable electric gage for, 153
Water level; gage for, design of, for cold weather service, 1714
recording of, instruments for, 153
Water rights; Kansas law on, 1276
selected problems in, in the West, 1272
Watersheds; infiltration studies on, 1706
Water-substance; properties of, 629
Weirs; ogee-profile; theoretical discharge coefficients for, 156
V-notch; coefficients of, viscosity and surface tension effects on, 1473
Welding; electric-arc; effects of gases and fumes of, 143
hazards in, control of, 1710
miter and intersection; comparison of, with welded fittings, 1112
pipe; methods of, 1111, 1708
steel; reservoir construction by, 1716
use of lead in, 1710

Wells; **947, 1703**
deep; pump for, installed 664 ft. underground, 1109
gas; casings of, cathodic protection of, 940
manganese in; poisoning from, 1287
remodeling of, at Turlock, Calif., 301
Wicking; use of, in pipe thread joints, 1112
Wimmera-Mallee, Australia; water supply developments at, 306
Windsor, Ont.; new filtered-water reservoir at, 1715
Winkler method; dissolved oxygen determination by, sulfamic acid modification of, 639
Wisconsin; lakes of, chlorophyll content, productivity and surface tension of, 763
northern; floods of unusual intensity in, 1582
Witwatersrand; water supply improvements on, 306
Wood; pipe construction with, 1711
staves; collars of, for main repair, 1712
Work loads; measurement of, in Los Angeles, 444
Wray Castle; investigations of freshwater bacteria at, 1470

Y

Yankton, S.D.; multiple floor plant at, 301
Ystwyth River, Wales; zinc pollution of, study of, 1580

Z

Zeolites; *see also* Base-exchange
capacities of, effect of temperature on, 780
carbonaceous; production of, from coal and coal refuse, 780, 781
organic; on mineral supports, 781
reduction of mineral content by, 779
reconditioning of, commercial process for, 781, 782
softening by, combined with corrosion control, 781
Zinc; dezincification; prevention of, comparative value of arsenic, antimony and phosphorus, 941
resistance to; testing of brass alloys for, 461
stream pollution by, in Ystwyth River, Wales, 1580

Authors of Abstracted Articles

Abrams, E. R., 1271
Ackermann, W. C., 1480
Adams, R. C., 771
Ahmed, A. A., 761
Aicher, R. V., 940
Aldama C., A., 1280
Aleev, B. S., 766
Alexander, L. J., 1584
Allgeier, R. J., 762
Allison, W. W., 1579
Allsopp, C. B., 1470
Anderson, A. P., 1712
Anderson, V. G., 632
Anthony, S. S., 134
Arlt, A. W., 160
Armbrust, H. J., 135, 139
Armstrong, W. D., 1283
Arnold, F. A., Jr., 142, 1282, 1283
Asheshov, I. N., 618
Atwood, A. W., 448

Babkin, M. P., 635
Bach, J. M., 641, 642
Baker, M., 1469
Baker, M. N., 302
Balch, F. K., 301
Banks, D. M., 943
Bannister, H. W., 294
Barber, E. G., 777
Bardwell, R. C., 311, 940
Barkley, J. F., 1573
Barnes, B. S., 1480
Barraclough, D. H., 1700
Barry, F. M., 461
Bartenev, G. M., 944
Bartlett, H. J., 942
Beardslee, C. G., 951
Beaumont, G. B., 296
Beavers, E. M., 945
Behre, C. H., Jr., 1267
Benedict, A. H., 1115
Benson, H. K., 1701
Benson, R. E., 1463
Bergman, L. A., 613
Berk, A. A., 311
Berry, A. E., 140, 617
Bessey, G. E., 1125
Betz, L. D., 637
BeVier, B. V., 612
Bigger, J. W., 626
Billings, L. C., 768
Binder, J. L., 615
Binnie, A. M., 159
Black, H. H., 955
Blackwelder, E., 1573
Blaine, R. L., 1124
Bland, H. A., 288
Blew, M. J., 1263
Bliss, J. H., 1584
Boerendans, W. L., 1108
Bogard, D., 780, 781
Bond, G. W., 774
Borishanskaya, F. M., 763
Borst, H. L., 1583
Botwright, W. E., 620
Boulton, W. S., 952
Bowden, N. W., 152
Bowles, O., 943
Boyles, W. A., 1468
Brackett, S., 768
Brashears, M. L., Jr., 948
Brater, E. F., 1477
Breaton, R. H., 635
Breedon, A. P., 441
Brinkman, R., 638
Brinley, F. J., 1699
Broderick, S. J., 780, 781, 782
Brooks, J. H., 940
Brown, C. E., 304
Brown, J. S., 1704
Brown, L., 135
Brown, R. H., 459
Browne, T. P., II, 1264
Bruner, D. W., 1469
Brust, H. F., 1576
Buchanan-Wollaston, H. J., 1468
Burgi, H., Jr., 1114
Burn, A. H., 612
Burns, W. E., 1697
Burr, G. O., 768
Bush, V., 439
Bustamante, M. E., 1280
Byram, A. T., 1707

Caley, E. R., 941
Calvert, C. K., 769
Cameron, F. K., 945
Camp, T. R., 135, 768
Campbell, R. S., 766
Campi, F., 297
Cantiçao, A. de L., 1458
Capen, C. H., 134, 609

Capocchi, J., 1702
Carder, D. S., 1714
Carlson, W. E., 1458
Carswell, T. S., 766
Casini, V., 632
Chamberlin, N. S., 138, 1459
Chandler, D. C., 767
Chant, H. L., 1281
Charnock, P., 135
Chase, E. S., 135
Chawla, A. P., 1469
Cherkinskiĭ, S. N., 1701
Cheyne, V. D., 1283
Churchill, E. S., 620
Ciapetta, F. G., 632
Clark, S. C., 151
Clarke, C. W. E., 941
Clarke-Hafstad, K., 1481
Classen, A. G., 448
Clauberg, K. W., 619
Coblentz, J. M., 628
Coe, R. H., 637
Coggeshall, L. T., 768
Cohen, M. M., 135
Cohen, S., 639
Cohn, M. M., 956, 957
Cole, A. E., 768
Collet, M. H., 153
Collins, W. D., 1584
Conklin, J. A., 1475
Conn, H. J., 620
Consoer, A. W., 769, 770
Cooper, H. H., Jr., 949
Cooper, H. L., 1107
Cooper, S. S., 635
Cort, W. W., 768
Councell, C. E., 130
Cox, C. R., 141, 768, 1281
Crawford, H. V., 1110
Crawley, H. H., 1265
Crisp, E. A., 953
Cronin, H. F., 952
Cross, R., 1125
Crutchfield, W. E., Jr., 1461
Cutter, V. M., 1574
Cyr, R., 303, 1715

Dardanelli, P. V., 312
Davenport, G. L., Jr., 780
Davenport, J. A., 148
Davenport, R. W., 152, 1584
Davidson, J. E., 1271
Davies, R. G., 301
Davis, C. L., Jr., 958
Davis, D. S., 640, 641
Davison, A. H., 151
Davison, R. O., 1282
Dean, H. T., 1282
de Andrade, E. G., 946
Debler, E. B., 154
DeCapito, T. M., 1280
DeEds, F., 1283
de la Serna, C. S., 781
de Monte, A. J. H., 1471
Denner, J., 1707
Dennison, E. S., 1473
Deutschlander, H., 772
Devendorf, E., 458
Dewante, R. H., 156
Dick, R., 1710
Domogalla, B., 768
Dorfman, P. A., 765
Dorsey, N. E., 629
Draper, W. F., 1694
Dukhinova, M. M., 1460
Dunn, J. S., 770
Dunstan, G. H., 1263
Duryee, L. M., 939

East, B. R., 1283
Easterwood, H. W., 1463
Eastes, J. W., 633, 634
Echavez, P., 138
Edmunds, F. H., 951, 952, 953
Edwards, P. R., 1469
Einert, H. E., 309
Eisenhart, L. P., 760
Eisenlohr, W. S., Jr., 152
Ellis, F. K., 1704
Ellsworth, S. M., 135, 1103
Ellwood, A., 1475
Elvove, E., 1282
Engle, H. M., 1713
Ernst, F. C., 1115
Escarza, F., 1282
Evans, U. R., 777
Evensen, O. K., 140
Ewing, S., 939

Fain, J. M., 1701
Fair, G. M., 135
Fairhall, L. T., 637, 1284
Fancott, E., 1716
Farrand, G. N., 1107
Fee, J., 159
Ferney, L. A., 1113, 1714
Ferramola, R., 1469
Finlay, G. R., 643
Flook, E., 1279
Flynn, H., 310
Flynt, F. L., 1479
Foltz, A. V., 940
Foster, E. E., 1583
Foster, M. D., 1703
Foster, W. C., 1462
Foulk, C. W., 635
Fox, L. A., 1692
Fox, M. C., 447
France, R. L., 770
Frank, N., 627
Frant, S., 1281
Freeman, A., 460
Freeman, H. F., 772
Freitag, 140
French, C. L., 638
Friend, G. E., 147

Fry, A. S., 1479
Fuchs, A. W., 457
Fugate, G. L., 1704
Fuller, H. U., 135
Furman, R. W., 613
Furnas, C. C., 635

Gan, G. S., 149
Ganapati, S. V., 766, 777
Gardiner, A. C., 766
Gardner, C., 1263
Gaskill, J. F., 442
Gehm, H. W., 1702
Geil, G. W., 460, 940
Gelfand, M., 296
Gelford, M., 766
Gerber, W. D., 947
Gerrard, W. F., 294, 310
Gibbs, F. S., 135
Gilcreas, F. W., 616
Ginzburg, F. I., 1701
Gledhill, E. G. B., 1261
Gliddon, C., 1124
Goldblith, S. A., 1264
Goodnight, C. J., 1699
Goodwin, R. C., 1463
Gotaas, H. B., 147
Gotschlich, E., 140
Gotting, H., 1118
Goudey, R. F., 613, 779
Gourley, H. J. F., 952, 1262
Greeley, R. B., 1574
Griffin, A. E., 138
Grundfest, H., 1267, 1694
Guillerm, J., 629
Guseva, K. A., 765
Guthrie, E. S., 639
Gutteridge, H., 1569

Haase, L. W., 312
Haering, D. W., 463, 772
Hafford, B. C., 762
Hale, F. E., 1285
Hale, J. E., 135
Haley, J. M., 155
Hall, R. E., 310
Halvorson, H. O., 622, 956
Hand, D. B., 639
Hanenberg, A. L., 1579
Happ, S. C., 768
Harding, S. T., 1584
Hardman, Y., 763
Hardy, A. V., 1280
Harkness, B., 1114
Harris, J. B., 763
Harrison, A., 780
Harrison, R., 303
Harrison, R. G., 760
Harrold, J. C., 152
Harrold, L. L., 1478
Hart, W. B., 958
Harvey, J. M., 294
Harvey, L., 940
Harvill, C. R., 950
Hatfield, W. D., 616
Haupt, H., 462
Hawkins, G. A., 460
Hayward, A. E., 618
Hazlehurst, T. H., 635
Heath, R. F., 149
Heisig, G. B., 1462
Hellstrom, B., 954
Heniques, J. F. T., 1117
Herpers, H. F., 463
Hershey, A. D., 624
Hess, O. B., 940
Hettche, H. O., 619
Heukelekian, H., 623, 768
Hill, R. A., 1584
Hill, W. R., 939, 939
Hirsch, A. A., 459, 616
Hiura, M., 147, 632
Hixon, A. W., 639
Hoak, R. D., 954
Hollopeter, S. L., 306
Holmes, J. A., 942
Hoover, C. R., 637, 1577
Hopkins, E. S., 448, 763
Horner, W. W., 1478
Horstmann, F. B., 311
Horton, P. H., 1459
Horwood, M. P., 626
Hostettler, C. O., 626
Hotchkiss, N., 768
Howard, J. E., 949
Howard, N. J., 617, 624, 771, 773, 1267, 1471, 1573, 1703
Howson, L. R., 299
Hoyt, J. C., 1476
Hoyt, W. G., 1580
Hubbs, C. L., 768
Huberty, M. R., 948
Huddleson, I. F., 457
Huddleston, W. E., 940
Hugelmann, H., 775
Hughes, J., 1459
Hukuzumi, S., 1287
Hunt, J. J., 1119
Hunter, D. H., 138
Hunter, J., 447
Hutchins, W. A., 1272
Hymas, F. C., 133

Ikuta, H., 1287
Ingleson, H., 780
Ingols, R. S., 1465
Iokhel'son, D. B., 616, 1460
Irany, E. P., 634

Jacobs, N. B., 298
Jaegers, K., 635
James, W. E., 632
Jameson, W., 131
Jameson, W. E., 614
Jamison, J. C., 294
Jarcho, S. W., 1281

JARVIS, C. S., 1479, 1584
JARVIS, W. J., 308
JARZ, E. F., 606
JAY, P., 1282
JENNISON, M. W., 147, 768
JENS, S. W., 1478
JENSEN, J. A., 784, 784
JEWETT, F. B., 760
JOHNS, G. A., 1461
JOHNSON, A. F., 154, 1584
JOHNSON, D. W., 956
JOHNSTON, I. W., 295
JONES, J. R. E., 1580
JONES, K. K., 143
JONES, L. M., 636
JUDAY, C., 762
JUDAY, R. E., 763

KABAT, E. A., 1267
KAHLER, H. L., 636
KALINSKE, A. A., 157
KALLMAN, S., 638
KAMMERMEYER, K., 615
KARPOFF, K. P., 159
KAUFFMANN-GRINSTEAD, K., 1270
KAUFMAN, C. E., 310
KAWAMURA, R., 1287
KAY, K., 133
KEEFER, C. E., 776
KEENAN, R. G., 637
KEHR, R. W., 1697
KEITH, J. C., 1715
KELLY, E. H., 1470
KELLY, F. W., 1698
KEMPF, J. E., 142
KENNARD, J., 953
KENNEDY, R. E., 157
KENNY, E. J., 948
KERSHAW, N. F., 1459
KESSLER, L. H., 768
KICHENKO, M. G., 619
KICHENKO, N. G., 619
KING, B. C., 311
KITTREDGE, A. E., 312
KITTRELL, F. W., 1577
KLASSEN, C. W., 955
KLEIN, A., 782
KLEINHEKSEL, S., 461
KLUCHESKY, E. F., 637
KNAPP, G. S., 1276
KNILL, W. C., 953
KNOWLES, C. R., 311
KNOWLSON, J. S., 1266
KODAMA, T., 1287
KOLODNY, M. H., 1280
KORZENOVSKY, M., 622
KOZELKA, F. L., 637
KRAPPE, J. M., 943
KRASAUSKAS, J. W., 622
KRATZ, H., JR., 776
KRISHNAN, K. V., 1469
KRYLOVA, A. N., 625
KUEBLER, C. A., 757
KUGLER, A. N., 1111, 1708
KURATA, S., 1287
KUYPER, A. C., 636

LACKEY, J. B., 768, 1697, 1699
LADUE, W. R., 613
LAKOMKIN, I. G., 1458
LAMAR, W. L., 1462
LAMBERT, C. F., 299, 445
LAMBORN, R. E., 1581
LAMMERS, F. J., 295
LANGBEIN, W. B., 1478
LARNER, J. L., 1458
LASH, S. D., 756
LATASTE, C., 629
LAUX, K., 151
LAWRENZ, M., 1464
LEA, F. M., 1125
LEA, W. L., 768
LEACH, D. A., 1116
LEES, J. C., 144
LEMBCKE, P. A., 458
LENZ, A. T., 1473
LEON, A. P., 1282
LEOPOLD, A., 768
LEOPOLD, L. B., 1706
LERNER, A., 1462
LETONOFF, T. V., 637
LEVAN, J. H., 1263
LEVINE, M., 136, 620, 628
LEVVY, G. A., 144
LEWIS, J. S., JR., 1122
LEWIS, M. R., 155, 1584
LEWIS, W. M., 950
LICHTENBERG, H., 461
LIND, E. M., 764
LINDSAY, J. E., 1458
LINFORD, A., 153, 1473
LINNEBOE, J. B., 296
LINSLEY, R. K., JR., 1480
LIPPERT, P., 1111
LITTON, J. B., 1463
LLOYD, D., 1476
LOCHHEAD, A. G., 1471
LOGAN, K. H., 937, 938
LONGLEY, F. F., 1263
LONGWELL, J. S., 298
LORENZ, M., 143
LOWRY, R. L., JR., 154, 1584
LUBEN, F., 942
LYNES, W., 941

MACK, M. G., 1280
MACMORINE, H. G., 620
MAGUIRE, J. J., 637
MALLMAN, W. L., 620
MANNING, W. M., 763
MARSHALL, L. A., 139
MARTIN, G., 957
MASSEL, M. S., 442
MASSELLI, J. W., 637, 1577
MATHEWS, H. M., 1704
MATTHEWS, F. J., 311

MAXWELL, W. H., 1705
McADAM, D. J., JR., 460, 940
McCALL, G. B., 763
McCANLIS, A. W. H., 1261
McCLENDON, J. F., 1462
McCLUNG, L. E., 773
McCLURE, F. J., 142, 1282, 1283
McCONNELL, A. F., 295
McCORMICK, D. R., 1458
McCOY, E., 768
McCRADY, M. H., 1471
McDIARMID, F. J., 1106
McEWEN, G. F., 762
McFADDEN, D. B., 627, 629
McKELVEY, V. E., 762
McMULLEN, D. B., 768
McNEICE, L. G., 304
McNUTT, P. V., 1103
MEAD, W. H., 1114
MEARS, R. B., 459
MELLON, M. G., 638, 638
MELVIN, R. W., 433
MERRIELL, F. C., 1120
MEYER, A. F., 950
MEYER, O. H., 157
MILLER, E. P., 957
MILLER, J. E., 148
MILLER, L. B., 944
MILLIKEN, F. A., 1574
MITCHELL, H. H., 1464
MITCHELL, N. W., 461
MIX, A. E., 642, 642
MONTEVERDE, J. J., 1469
MONTGOMERY, J. M., 780
MOORE, E. W., 135, 458, 1698
MOORE, R. W., 461
MOORE, W. L., 1471
MORRILL, A. B., 1279
MORRILL, M. C., 460
MORRIS, R. M., 1583
MORRISON, W. S., 296
MORTIMER, C. H., 616
MORTON, B. B., 462
MORTON, E., 953
MOSENTHIN, F., 1707
MOSHER, W. E., JR., 1281
MOSS, M. L., 638
MOUNTIN, J. W., 1279
MUDRETSOVA, K. A., 766
MUIR, J. F., 1476
MUNGER, M., 457
MUNTER, C. J., 782
MURTY, G. V. L. N., 1459, 1459
MUSGRAVE, A. S. G., 1102
MUSGRAVE, G. W., 1479
MYERS, F. J., 633
MYERS, R. J., 633, 634

NAGAOKA, Z., 461
NALCHAJIAN, W. D., 626
NASON, H. K., 766
NEEDHAM, J. G., 768
NELIDOV, I., 156
NELLIS, J. G., 769
NELSON, J. H., 626
NEVILLE, H. A., 635
NICCOLI, E., 632
NICHOLAS, J. S., 1694
NIELSON, H., 781
NIX, H., 775
NOE, W. L., 1276
NOLL, C. A., 637
NORCOM, G. D., 940
NORDELL, E., 945

O'BRIEN, J. E., 616
O'CONNELL, W. J., JR., 942
OLIN, H. L., 772
OL'KENITSKI, I. S., 1467
OLSON, R. A., 1576
OROSCO, E., 946
OSBORNE, J. G., 615
OWENS, E. E., 311
OWINGS, C. W., 611

PARKER, D. J., 611
PARKER, L. T., 957, 1275, 1276
PARR, L. W., 627
PARTRIDGE, E. P., 310
PASRICHA, C. L., 628, 1471
PATTERSON, W., 460
PAUL, B. M., 628
PEARCE, C. E., 158
PEARL, E. H., 771
PEARL, I. A., 1701
PELUFFO, C. A., 1469
PEQUEGNAT, M., 1582
PETERS, C. A., 638
PETERSON, J. S., 1281, 1282
PHILLIPS, G., 150
PHILLIPS, G. E., 616
PIERCE, H. B., 632
PIPER, J. D., 1118
PIWOWARSKY, E., 460
PLACAK, O. R., 1697
PLACE, P. B., 312
POHL, M. V., 1571
PORTH, D. L., 1463
POTTER, A. A., 460
POTTER, H. H., 135
POWELL, R. W., 157
POWERS, J. P., 311
POZEN, M. A., 295
PRAEGER, A. H., 309
PRICE, O. A., 1108
PRICKETT, P. S., 1287
PRINGLE, C. P., 1465
PURDY, A. C., 310
PURDY, W. C., 1697

RABASA, E., 1282
RADDER, N. J., 1708
RAEBURN, C., 306
RAMSER, C. E., 1478
RANDLETTE, J. W., 135
RAO, Y. K. R., 1578

RAUX, J., 295
REDDICK, H. E., 152
REID, G. U., 1108, 1108
REILLY, T. L., 1583
RENN, C. E., 768
RHOADES, R., 947
RICE, C. W., 943
RICHTER, H., 462
RICHTER, R. C., 295
RIDDELL, W. A., 148
RIDDICK, T. M., 148
RIDDLE, K. B., 1287
RIEDLE, H., 149
RIFFENBURG, H. B., 1579
ROBBINS, M. L., 627
ROBERTSON, J. M., 155
ROBINSON, G. B., 445
ROBINSON, R. J., 1462
ROCHA, E. F., 946
RODE, L. J., 618
ROE, A. F., 1466
ROGERS, W. F., 939
ROHLICH, G. A., 768
RÖMCKE, O., 140
ROUSE, H., 155, 157
ROWNTREE, N. A. F., 1262
ROZENFEL'DT, A. N., 1467
RUBBO, S. D., 1470
RUCHHOFT, C. C., 639, 639
RUDOLFS, W., 623, 768
RUDOLPH, A. S., 136
RUSSELL, G. E., 135
RUSTIGIAN, R., 1469

SAIFER, A., 1459
SALLE, A. J., 622
SANBORN, N. H., 1700
SANDHOLZER, L. A., 625
SARLES, W. B., 138, 768
SAVAGE, G. M., 622
SCHAEFFER, J. G., 145
SCHAFMAYER, A. J., 1478
SCHAPHORST, W. F., 1112
SCHERAGO, M., 627
SCHLOSSER, E. G., 1281
SCHNEIDER, J. H., 1113
SCHNEIDER, W. H., 1124
SCHNOLL, N., 770
SCHROEDER, W. C., 311
SCHULEEN, E. P., 159
SCHULHOFF, H. B., 623
SCHULMEISTER, W. A., 1711
SCHWALEN, H. C., 154
SCHWARTZ, C., 782
SCOFIELD, C. S., 1584
SCOTT, G. N., 938
SCOTT, G. R., 955
SEARLES, R. M., 1576
SEARS, P. B., 768
SEEGMILLER, C. G., 1463
SERDOBOVA, E., 643
SETON, L. H., 1713
SHAKHKELDIAN, A. B., 643
SHARP, P. F., 639
SHEPLEY, J. M., 761
SHERMAN, G. F., 1112
SHERMAN, L. K., 1478, 1481
SHROCK, R. R., 463
SHYUKU, K. R., 618
SIEGERT, H., 1463
SILMAN, H., 460
SILVEY, J. K. G., 763
SINACORI, M. N., 947
SINCLAIR, F. K., 1262
SIROTINA, A. I., 1465
SKINNER, C. E., 627
SLESINSKI, F. A., 632
SLIGHT, G. M., 1476
SLOCUM, G. G., 1467
SMIRNOV, K. M., 149
SMITH, E. E., 940
SMITH, E. V., 768
SMITH, H. L., 1706
SMITH, M. W., 765
SMITH, N., 309
SMITH, S., 1102
SNELL, F. D., 1701
SNIESZKO, S. F., 768
SNYDER, F. F., 1481
SOGNNAES, R. F., 1283
SOLBERG, L. H., 460
SOULE, M. H., 142
SOUTHARD, F. E., 135
SPAULDING, L. H., 1712
SPECTOR, B. K., 1280
SPLITTGERBER, A., 311
STAALSON, N. W., 138
STABLER, H., 1584
STAINSBY, W. J., 133
STANLEY, C. M., 1103
STARK, C. N., 625
STARKWEATHER, W. L., 311
STEVENS, S., 775
STEWART, M. G., 1704
STODDARD, C. K., 311
STONES, T., 778, 1455
STOURDZÉ, Y. E., 1460
STOUT, W., 1581
STOWELL, E. R., 156
STRATEMEYER, E. P., 149
STRAUGHN, W. R., JR., 625
STRINGFIELD, V. T., 949
STRUNK, W. L., 1581
STUART, C. A., 1468
STUEBBEN, C. A., 311
SUITER, H. B., 610
SULLIVAN, E. C., 1104
SWAROOP, S., 1466
SWEARINGEN, C. V., 947
SWEENEY, O. R., 765, 1463
SWINGLE, H. S., 768
SYMONS, G. E., 1572
SZADECZKY-KARDOSS, E., 949

Tapley, G. O., 147, 768
Tartakovskiĭ, V. Y., 1464
Tatum, F. E., 1478
Taylor, A. M., 133
Taylor, H. M., 1106
Taylor, H. W. Y., 141
Taylor, R. K., 1464
Tenner, I., 444, 447
Tenney, A. H., 639
Thaller, H. I., 1467
Thomas, A. H. R., 140
Thomas, H. A., 159
Thompson, D. H., 768
Thomson, D. H., 953
Thorne, M., 135
Thuma, R. A., 783
Thurston, N. W., 135
Tian, G., 306
Tomlinson, H. M., 632
Townsend, W. H., 1706
Tracy, R. L., 623
Treffler, A., 782, 1464
Trelles, R. A., 641, 642
Treon, J. F., 1461
Tressler, W. L., 1576
Trout, W. E., Jr., 1458
Tubaki, S., 1287
Tucker, J., Jr., 1124
Tupholme, C. H. S., 1570
Turgasen, V. L., 296
Turner, R., 1711
Twenhofel, G. H., 768
Twenhofel, W. H., 762
Tyuda, K., 147

Uhlig, H. H., 460
Umbreit, W. W., 768
Upthegrove, C., 941
Utterback, C. L., 768

Vaksberg, N. M., 1471
Vanoni, V. A., 155
Van Oosten, J., 768
van Schreven, A., 638
van Vliet, R., 1481
Vasil'ev, A. S., 1460
Vaughan, H., 144
Vialard-Goudou, A., 629
Viehl, K., 623
Visher, S. S., 1583
Vivian, J. E., 640
Volkova, O. Y., 628
Vonnegut, B., 463
Vranyale, I. M., 763

Wachter, R. E., 1114
Waksman, S. A., 146, 620, 768, 1471
Walker, O. J., 643
Walters, R. C. S., 952
Walther, B., 782
Walton, C. B., 761
Waring, F. H., 437
Warren, F. B., 446
Warren, M. A., 949
Watanabe, A., 461
Watanabe, M., 461, 630, 631
Watt, J., 1280, 1282
Weaver, R. H., 627
Weber, G. R., 620
Webster, S. H., 143
Weckel, K. G., 771
Weir, P., 777
Welch, P. S., 768
Weld, W. A., 1581
Werner, B. L., 1119
Weston, R. F., 958
Weston, R. S., 135
Weston, W. H., 768
Wheeler, S. M., 1281
White, A. E., 941
White, H. L., 1704
Whitehead, R., 446
Whitney, R. P., 640
Wicks, L. F., 632
Wiedeman, H. F., 777
Wiederholt, W., 940
Wiley, J. S., 1104
Wilkinson, L., 143, 1284
Williams, B. F., 1579
Williams, H. A., 132
Wilm, H. G., 153
Wilson, D. C., 142, 142
Wilson, S. H., 143, 1284
Wilson, W. E., 156
Wilton, R. G., 1707
Winter, T. S. R., 1266
Wisler, C. O., 1477
Wolman, A., 144
Wood, W. J., 1482
Woodburn, R., 1583
Woodruff, H. B., 146
Woods, J. T., 638
Woster, H. C., 1478
Wright, K. A., 1712
Wright, R. K., 159
Wright, W. A. S., 940
Wuraftic, J., 776
Wynne, E. S., 618

Yamada, R., 1287
Yasnov, B. M., 765
Yoder, J. D., 310
Yokota, Y., 147
Yoneyama, T., 461
Young, J. W., 760
Youngquist, C. V., 1581

Zentner, E., 784
Zimmerman, A., 1469
Zischg, W., 619
Zvenigorodskaya, A. Y., 1471

A.W.W.A.

PUBLICATIONS

Books

MANUAL OF WATER QUALITY AND TREATMENT.—A 300-page *Manual* of information brought up to date from material originally published in 1925 as a part of the Manual of Water Works Practice. The rewriting was directed by Paul Hansen and the late Lewis V. Carpenter. Eleven chapters cover: Characteristics of Available Sources; Organisms in Water; Standards of Quality; Purification Occurring in Streams, Lakes and Reservoirs; Partial Treatment and Treatment Preliminary to Filtration; Coagulants and Coagulation; Chlorine and Other Chemicals; Tastes and Odors; Filtration; Chemical Conditioning of Waters; and Treatment Plant Control. The book is complete with over 50 illustrations, graphs and charts and has a complete index and bibliography. Published in 1940; reprinted in 1941. Price to A. W. W. A. Members, $2.50; to A. W. W. A. Members who send cash with order, $2.25; to non-members, $3.00.

INDEX TO THE PROCEEDINGS, JOURNAL AND OTHER PUBLICATIONS.—This Index covers 59 years of A. W. W. A. publications: the Proceedings for 1881 through 1913; the Journal for 1914 through 1939; and other Association publications. In the 285 pp. of the book are given: a chronological listing of all published papers (grouped under 70 major subjects of the water works field); a complete author index; and a list of other publications of the A. W. W. A. or published in co-operation with other organizations. Price to A. W. W. A. Members, $1.75; to A. W. W. A. Members who send cash with order, $1.50; to non-members, $2.00.

MANUAL OF WATER WORKS ACCOUNTING.—Prepared jointly by the A. W. W. A. and the Municipal Finance Officers Association, this 500-page Manual contains twenty chapters covering: Accounting Organization and Control; Accounts; Books of General Entry and Accounting Documents; Customer Accounting Procedure up to Time of Billing; Customer Billing and Bookkeeping; Purchases; Accounting for Materials and Supplies; Payroll Accounting; Accounting for Contractual Services, Interest on Notes, and Taxes; Depreciation; Distribution of Clearing Accounts; Cost Accounting; Accounting for Cash; Restricted Funds; Investments; Plant Accounting; Creditor and Ownership Equities; Preparation of Financial Statements; and Financial Policies and Planning. Published in 1938. Price, for general sales, $4.00; to A. W. W. A. Members who send cash with order, $3.20.

STANDARD METHODS FOR THE EXAMINATION OF WATER AND SEWAGE.—Published jointly by the A. W. W. A. and the American Public Health Association with collaboration of the American Chemical Society. Eighth Edition, 1936. Cloth bound, 300 pages. Available through the American Public Health Association, 1790 Broadway, New York, N. Y., at $2.50 per copy.

WATER-BORNE OUTBREAKS IN THE UNITED STATES AND CANADA AND THEIR SIGNIFICANCE.—By Arthur E. Gorman and Abel Wolman. Published in the February 1939 JOURNAL, p. 225. This 150-page book is a unique compilation and a valuable interpretation. Published separately from the JOURNAL at $1.00 per copy.

Specifications for Cast-Iron Pipe, Fittings, Lining and Laying

AMERICAN RECOMMENDED PRACTICE MANUAL FOR THE COMPUTATION OF STRENGTH AND THICKNESS OF CAST-IRON PIPE—A.S.A. A21.1–1939.—Adopted by the A. W. W. A. December 1939 and published as a part of the December 1939 JOURNAL. 81 pp. Reprints, 40¢ per copy.

AMERICAN STANDARD SPECIFICATIONS FOR CAST-IRON PIT CAST PIPE FOR WATER OR OTHER LIQUIDS—A.S.A. A21.2–1939.—Adopted by the A. W. W. A. December 1939 and published as a part of the December 1939 JOURNAL. 23 pp. Reprints, 20¢ per copy.

AMERICAN STANDARD SPECIFICATIONS FOR CEMENT MORTAR LINING FOR CAST-IRON PIPE AND FITTINGS—A.S.A. A21.4–1939.—Adopted by the A. W. W. A. December 1939 and published as a part of the December 1939 JOURNAL. 9 pp. Reprints, 15¢ per copy.

STANDARD SPECIFICATIONS FOR CAST-IRON SPECIAL CASTINGS.—The portion of the A. W. W. A. 1908 Specifications for Cast-Iron Water Pipe and Special Castings which relates to special castings has not yet been superseded by new material produced by the American Standards Association Committee A21. Until such time as this Committee completes its report A21.7, the A. W. W. A. 1908 Specifications continue to be a basis for purchase *insofar as they relate to special castings only*. 36 pp. Reprints, 30¢ per copy.

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Specifications for Steel Pipe and Coatings

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TENTATIVE SPECIFICATIONS FOR LOCK-BAR PIPE—7A.2-T.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and approved only as Tentative Specifications by the A. W. W. A. April 25, 1940. 12 pp. Reprints, 15¢ per copy.

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STANDARD SPECIFICATIONS FOR STEEL WATER PIPE OF SIZES UP TO BUT NOT INCLUDING 30 INCHES—7A.4-1941.—Published as Tentative Specifications as a part of the June 1940 JOURNAL and adopted as Standard by the A. W. W. A. June 26, 1941. 28 pp. Reprinted under one cover with 7A.3-1940, 25¢ per copy.

STANDARD SPECIFICATIONS FOR COAL-TAR ENAMEL PROTECTIVE COATINGS FOR STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—7A.5-1940.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. April 25, 1940. 38 pp. Reprinted under same cover as 7A.6-1940, description of which follows.

STANDARD SPECIFICATIONS FOR COAL-TAR ENAMEL PROTECTIVE COATINGS FOR STEEL WATER PIPE OF SIZES OF 4½ INCHES OUTSIDE DIAMETER UP TO BUT NOT INCLUDING 30 INCHES—7A.6-1940.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. April 25, 1940. 32 pp. Reprinted under one cover with 7A.5-1940, 30¢ per copy.

STANDARD SPECIFICATIONS FOR CEMENT-MORTAR PROTECTIVE COATING FOR STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—7A.7-1941.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. June 26, 1941. 22 pp. Reprints, 20¢ per copy.

Specifications for Valves, Sluice Gates and Fire Hydrants

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TENTATIVE SPECIFICATIONS FOR SLUICE GATES—7F.2-T.—Approved as Tentative Specifications by the A. W. W. A. June 26, 1941 and published as a part of the October 1941 JOURNAL. 11 pp. Reprints, 15¢ per copy.

STANDARD SPECIFICATIONS FOR FIRE HYDRANTS FOR ORDINARY WATER WORKS SERVICE—7F.3—1940.—Adopted as Standard Specifications by the A. W. W. A. January 17, 1940 and published as a part of the August 1940 JOURNAL. 12 pp. Reprints, 15¢ per copy.

UNIFORM MARKING OF FIRE HYDRANTS: STANDARD COLORS FOR PAINTING TO INDICATE FLOW CAPACITY—7F.3.1-1937.—Published in the April 1937 JOURNAL and adopted by the A. W. W. A. June 7, 1937. 2 pp. Reprints, 5¢ per copy.

Other Specifications

STANDARD SPECIFICATIONS FOR ELEVATED STEEL WATER TANKS, STANDPIPES AND RESERVOIRS—7H.1-1942.—Published as Tentative Specifications as a part of the December 1940 JOURNAL and adopted as Standard by the A. W. W. A. June 26, 1941 and by the American Welding Society July 23, 1941. Revised as of October 1, 1942. 51pp. Reprints in two sizes (8½ in. by 11 in. for binding with contract documents, and 6 in. by 9 in. for reference), 30¢ per copy.

TENTATIVE SPECIFICATIONS FOR COLD WATER METERS—DISPLACEMENT TYPE—7M.1-T.—Approved as Tentative Specifications by the A. W. W. A. November 1941 and published as Tentative Specifications in the December 1941 JOURNAL. (With Emergency Alternate Provisions issued as of December 1, 1942.) 14 pp. Reprints, 20¢ per copy.

EMERGENCY ALTERNATE SPECIFICATIONS FOR SULFATE OF ALUMINA—1942.—Published in the July 1942 JOURNAL. 2 pp. Reprints, 10¢ per copy.

Committee Reports and Recommended Practices

REPORT ON CHEMICAL HAZARDS IN WATER WORKS PLANTS—CHLORINE—5B.1-1935.—Published in the September 1935 JOURNAL. 24 pp. Reprints, 20¢ per copy.

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REPORT ON CHEMICAL HAZARDS IN WATER WORKS PLANTS—SULFUR DIOXIDE AND CAUSTIC SODA—5B.3-1939.—Published in the March 1939 JOURNAL. 13 pp. Reprints, 20¢ per copy.

REPORT ON SPECIFICATIONS AND TESTS FOR WATER PURIFICATION CHEMICALS—POWDERED ACTIVATED CARBON.—Published in the July 1938 JOURNAL. 92 pp. Now available only as part of the Journal, 75¢ per copy.

RECOMMENDED PRACTICE FOR DISTRIBUTION SYSTEM RECORDS—7G.1-1940.—Published in the February 1940 JOURNAL. 61 pp. Reprints, including two related papers covering "Office Forms" and "Co-ordinating Operating System Records With Accounting Records, 25¢ per copy.

Standard Schedule

For

Grading

Cities and Towns of the United States

With Reference

To Their Fire Defenses and Physical Conditions

National Board of Fire Underwriters

New York

Adopted, December 14, 1916

Edition of 1942

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This material as recently revised is presented here for the information and reference of the water works field, with the permission of George H. Booth, Chief Engineer, The National Board of Fire Underwriters, 85 John Street, New York, N. Y.

INTRODUCTORY

The Grading Schedule is based upon the plan of assigning to the various features of fire defense found in cities of the United States, points of deficiency depending upon the extent of variance from standards formulated from a study of conditions during the past 35 years; the natural and structural conditions which increase the general hazard of cities, and the lack of laws or of their enforcement for the control of unsatisfactory conditions, are graded in the same way. The word "city" is used in this schedule in a broad sense and includes towns, villages, districts or other municipal organizations. The sum of the maximum points of deficiency totals 5,000 and is divided in accordance with the relative values of the features considered as given below.

RELATIVE VALUES.

	Per Cent	Points
Water Supply	34	1,700
Fire Department	30	1,500
Fire Alarm	11	550
Police	1	50
Building Laws	4	200
Fire Prevention	6	300
Structural Conditions	14	700
	100	5,000

It is recognized that climatic conditions affect fire losses, by reason of the frequency of fires due to the heating hazard, by retarding the response of fire apparatus, by hampering effective fire fighting during cold weather and storms, by the increase in combustibility due to hot and dry weather, and by the greater probability of fires spreading at time of high winds. Also that earthquakes, tornadoes, hurricanes, cyclones, blizzards, floods and other unusual conditions have an influence on the conflagration hazard. These elements are to a greater or less degree common to the whole country, and therefore no deficiency is considered in the Schedule for normal climatic conditions. Some sections of

the country, however, are subject to abnormal climatic conditions, and to cities in these sections, a super-deficiency is applied, as given on page 77. This super-deficiency is to be added to the deficiency determined by the application of the Schedule proper.

A good water supply in connection with a poor fire department, or *vice versa,* is of less value than if both are good. In recognition of this, a modification of the better one of the two features is made, in accordance with the plan given on page 78, provided the divergence exceeds the equivalent of two classes.

The subjects considered in grading the various features are given on pages 4 to 8 and the details of grading on the pages following; the total of the points of deficiency is used in determining the class of the city or town graded, in accordance with the plan given on page 9.

In determining the points of deficiency to be applied to many of the items, it appears reasonable to use a graduated scale of points depending upon the per cent. of deficiency, with a lesser increment for the first 30 per cent. than for the remainder; that is, a deficiency of 10 per cent, in good or moderately good conditions, has less actual effect than where conditions are poor. Such a scale has been prepared; either the full scale, a multiple or a fractional part thereof is used, depending upon the relative weight or importance of the item under consideration.

To save space, this Scale is printed in full on page 3, and reference is made to it under each item to which it applies.

In general, the total *required* quantity or the total *required* number must be used as the basis in figuring the percentage of deficiency. Under Water Supply, if there is a deficiency under Item 6*b*, the quantity available on which this deficiency was obtained shall be used as a basis in figuring the percentage of deficiency of Items 7 to 16, inclusive, except for the Item on which the inadequacy occurs, in which case the total *required* quantity will be used.

DEFICIENCY SCALE.

(Points of deficiency corresponding to per cent. deficient.)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0	10	25	45	67	90	112	134	156	178	200
1%	1	12	27	47	70	92	114	136	158	180	
2%	2	13	29	50	72	94	116	138	160	182	
3%	3	15	31	52	74	97	119	141	163	185	
4%	4	16	33	54	77	99	121	143	165	187	
5%	5	18	35	57	79	101	123	145	167	189	
6%	6	19	37	59	81	103	125	147	169	191	
7%	7	21	39	61	83	105	127	149	171	194	
8%	8	22	41	63	85	108	130	152	174	196	
9%	9	24	43	65	88	110	132	154	176	198	

POINTS

Where the requirements are influenced by the height of buildings, as expressed in stories, a total height up to thirty-five feet may be considered as a two-story structure, forty-five feet as a three-story and fifty-five feet as a four-story.

Under certain items definite points of deficiency are assigned to certain conditions. When conditions found are judged to be intermediate between those listed, or when the minimum points specified appear not justified, points may be applied in proportion to the degree of deficiency.

Some modifications of the Schedule issued in 1930 have been incorporated in this edition. Changes in the wording have been made to clarify its meaning and to conform to present good practices, but these will not materially affect previous gradings of cities which have advanced with the times.

SUBJECTS CONSIDERED IN THE SCHEDULE.

Water Supply.

Item

1. Appointment of Employees.
2. Efficiency of Executive.
3. Records and Plans.
4. Emergency Provisions.
5. Receipt of Alarms by Department.
6. Normal Adequacy of Entire System.
7. Reliability of Source of Supply.
8. Sufficiency of Reserve Pump Capacity.
9. Sufficiency of Reserve Boiler Capacity.
10. Condition, Arrangement and Reliability of Plant Equipment.
11. Fuel and Accessories for the Transmission of Power.
12. Construction of Pumping Station.
13. Fire Protection of Pumping Station.
14. Hazards of Pumping Station.
15. Exposures to Pumping Station.
16. Reliability of Supply Mains as Affecting Adequacy.
17. Reliability of Installation of Supply Mains.
18. Completeness of Arterial System.
19. Reliability of Installation of Mains.
20. Effect of Small Mains in the High Value District Considered.
21. 4-inch Mains in System.
22. Dead Ends—4- and 6-inch Mains.
23. Completeness of Gridiron of 6-inch Mains.
24. Quality and Condition of Pipe.
25. Conditions Affecting Fire Protection in Other Than the Section Graded.
26. Spacing of Gate Valves.
27. Condition of Gate Valves.
28. Distribution of Hydrants in the High Value District Considered.
29. Ditto in Residential and Other Districts.
30. Condition of Hydrants.
31. Size and Installation of Hydrants.
32. Valves on Hydrant Branch.

Fire Department.

Item

1. Number of Officers.
2. Number of Operators.
3. Qualifications of Chief Officers.
4. Tenure of Office of Chief.
5. Appointment and Promotion of Officers.
6. Enlistment Requirements.
7. Retirement Requirements.
8. Number of Hose or Pumper Companies (Apparatus).
9. Number of Ladder Companies (Apparatus).
10. Distribution of Companies.
11. Total Required Manual Strength of Department.
12. Manual Strength of Existing Companies in the High Value District Considered.
13. Pumper Capacity.
14. Reserve Pumpers.
15. Condition of Apparatus.
16. Fire Boats.
17. Powerful and Special Stream Appliances.
18. Small Stream Appliances.
19. Reserve Hose Wagons.
20. Amount of Hose.
21. Condition of Hose.
22. Emergency Equipment.
23. Minor Equipment.
24. Fuel.
25. Repair Facilities.
26. Salvage Appliances.
27. Suitability of Fire Stations.
28. Discipline.
29. Drills and Training.
30. Response to Alarms.
31. Fire Methods.
32. Conditions Affecting Fire Department Operations.
33. Building Inspections.
34. Records of Fires, etc.

Fire Alarm.

Item

1. Qualifications of Management.
2. Adequacy of Maintenance Force.
3. Operators.
4. Headquarters Building.
5. Apparatus at Headquarters.
6. Circuit Protection.
7. Current Supply.
8. Circuits Underground.
9. Condition and Material of Circuits.
10. Circuits Near High-Potential.
11. Open or Grounded Circuits.
12. Overloaded Circuits.
13. Alarms to Fire Stations.
14. Condition of Inside Wiring.
15. Type of Boxes.
16. Conspicuousness and Accessibility of Boxes.
17. Condition of Boxes.
18. Distribution of Boxes.
19. Tests and Records.
20. Speed of Alarms.
21. Fire Department Telephone System.
22. Transmission of Telephone Alarms.
23. Provisions for Transmitting Telephone Fire Alarms from the Telephone Exchange.

Police.

1. Co-operation with Fire Department.
2. Deficient Signaling and Emergency Service.
3. Co-operation with Building Department.

Building Laws.

Item

1. Fire Limits.

2. Construction and Protection of Buildings.

3. Fire Resistive Roof Coverings.

4. Records.

NOTE.—Lack of Enforcement is Considered Equivalent to Absence of Law.

Fire Prevention

1. Electric Lighting and Heating.

2. Enforcement Agency for Fire Prevention.

3. Oil Lighting and Heating.

4. Gas Lighting and Heating.

5. Storage, Transportation and Use of Flammable Liquids.

6. Handling, Storage and Use of Hazardous Chemicals and Materials.

7. Control of Rubbish, Trash, Ashes, Bonfires, Packing Material and Junk.

8. Records.

NOTE.—Lack of Enforcement is Considered Equivalent to Absence of Law.

Structural Conditions.

Item

1. Area of District or of Largest Subdivision Made by Fire Breaks or Barriers.
2. Street Widths.
3. Accessibility of Block Interior.
4. Per Cent. of Area in Streets and Open Spaces.
5. Per Cent. of Block Area Built Upon.
6. Heights of Buildings Other than Fireproof.
7. Large and Excessive Areas Other than Frame.
8. Deficient Party and Fire Walls.
9. Unprotected Floor Openings.
10. Unprotected Exposed Openings.
11. Frame Buildings.
12. Permanent Awnings and Non-Fire-Resistive Roof Coverings.
13. Conflagration Breeding Blocks.
14. Exposures to District.

CREDITS

21. Superior Construction and Protection.
22. Pumper Capacity, where Water Supply at Direct Hydrant Streams is Adequate.
23. High Pressure Fire System.

Additional Deficiencies.

CLIMATIC CONDITIONS:

1. High Winds.
2. Excessive Snowfall.
3. Severe Cold Weather.
4. Hot Dry Weather.
5. Unusual or Exceptional Conditions.

DIVERGENCE IN GRADING OF FIRE DEPARTMENT AND WATER SUPPLY.

GRADING OF CITIES AND TOWNS BASED ON THE RELATIVE NUMBER OF POINTS OF DEFICIENCY IN FIRE DEFENSES AND PHYSICAL CONDITIONS.

A First Class City or Town
is one receiving 0 to 500 points of deficiency

A Second Class City or Town
is one receiving 501 to 1,000 points of deficiency

A Third Class City or Town
is one receiving 1,001 to 1,500 points of deficiency

A Fourth Class City or Town
is one receiving 1,501 to 2,000 points of deficiency

A Fifth Class City or Town
is one receiving 2,001 to 2,500 points of deficiency

A Sixth Class City or Town
is one receiving 2,501 to 3,000 points of deficiency

A Seventh Class City or Town
is one receiving 3,001 to 3,500 points of deficiency

An Eighth Class City or Town
is one receiving 3,501 to 4,000 points of deficiency

A Ninth Class City or Town
is one receiving 4,001 to 4,500 points of deficiency

A Tenth Class City or Town
is one receiving more than 4,500 points; or without a Water Supply and having a Fire Department grading 10th class; or with a water supply and no fire department; or with no fire protection.

Note.—This schedule measures the relativity of protection between one city and other cities, towns and villages. Where conditions diverge widely from the normal, the application of the schedule can only determine a portion of the probability

factors. Such conditions might be found in a community of mushroom growth, or one comprising largely amusement or seasonal activities, or consisting of only the buildings of an industrial nature with little residence population, or one where, because of discontinuance of a principal industry, there is a marked decline in values.

STANDARD GRADING SCHEDULE

WATER SUPPLY

It is recognized that a so-called gravity system, *i. e.*, one delivering supply directly to the city from the source without the use of pumps, is preferable from a fire protection standpoint, but a well designed and properly safeguarded direct pressure system, such as the high pressure fire systems of some of our large cities, so nearly approaches the gravity system in adequacy and reliability that no distinction is made between the two types.

In general, reliable fire protection requires such duplication of all parts of a water system that with such parts out of service as may reasonably be expected to be inoperative, the system will still be able to furnish the required fire flow. The introduction of *storage,* either elevated and supplying the distribution system or for suction supply, offsets to a greater or less degree the need of duplication in various parts of a system, the value of the storage depending upon its amount and location; as affecting reliability of supply, it appears to be a reasonable assumption that a storage sufficient to provide fire flow for 4 to 10 hours, depending upon the fire demand as given on page 14, during a period of 5 days of maximum consumption is sufficient to permit the making of most of the repairs, alterations or additions incident to the operation of a water supply system, and this assumption will be used as a basis in determining the extent of deficiency under Items 8, 9 and 16. The amount of storage and the probable time required to make repairs shall be taken into consideration in deciding on the degree of unreliability of Items 7, 10 to 15 and 17. In general all storage lessens the requirements of those parts of the system through which supply has already passed. In no case can a rate in excess of the actual capacity of the mains from the storage be considered. Where storage fluctuates as much as 10 per cent. during the 24 hours, the minimum storage maintained must be used in the calculations. Owing to the decrease in pressure when water is drawn down in standpipes, only the capacity of the top 25 feet can be considered as storage, unless situated on elevated ground and supply is to fire department pumpers.

The ability to utilize *emergency supplies* through connections to another system, or from a separate source, storage or equipment not normally used, must be considered in charging for deficiencies in the system under consideration, and credit given for the supply thus available at such pressures as may be required for adequate protection. These supplies are divided into two groups: 1st. Those owned or controlled by the same management as the system. Full credit may be given under items of reliability (Items 7 to 17, inclusive), where the supply comes in automatically or where definite arrangements are made for quickly drawing from the emergency supplies, with detail plans on file, showing locations of gates and pipe lines. If no such arrangements and plans, or the emergency supplies, because of pollution,* would be used only after conflagration conditions existed, credit shall be given for only ½ the points which these supplies decrease the deficiency of the system; if credit is allowed under Items 6a or b, the deficiency of Items 7 to 17, inclusive, will be based on the actual quantity available under normal conditions plus one-half the quantity available from the emergency source. Under adequacy (Item 6) the above credits will be made only where the emergency supply can be turned in within 30 minutes, unless sufficient storage is available to maintain adequate supply for a period of 2 hours.

2nd. Those under outside control where no contract agreement provides for their utilization by employees of the system. These shall be applied only for Items 7 to 17, inclusive, under which credit shall be given for ⅓ the points which the quantity available from these supplies decreases the deficiency of the system.

Where a system is supplied from 2 or more sources or supply works, or where there are 2 or more systems serving the same area, the source or system furnishing the maximum protection shall be considered as the primary one; if one system is available at direct hydrant stream pressure, the low pressure system

*The National Board of Fire Underwriters is opposed to allowing a credit for a polluted supply except where suitable means are provided for treating the water.

may be considered, in addition to the domestic consumption which it supplies, only up to the amount of pumper capacity available plus ⅓ the required fire flow, assumed as waste at fires. Application shall be made to the primary source or system, the deficiency of which to be offset in whole or in part in any individual item by the additional protection afforded by the secondary source or system. Where the system graded covers only the district considered, Items 21 to 32, inclusive, must be based in whole or in part on conditions in the other system.

Supply from fire boats delivered through pipe lines which are drained during a part of the year shall not be considered as emergency supply or as a second system in offsetting deficiencies in fire protection furnished by a domestic water system.

Where a water system exists, and canals, streams, ponds, wells and cisterns make suction supply for pumpers also available, the suction supply may be considered in its ability to offset the deficiency in the various items where it would apply, but not in excess of the pumper capacity available; in general, the only items affected will be Nos. 20, 28 and 29. Where no water system exists, such suction supply shall not be graded under Water Supply, a full deficiency of 1,700 points being allowed; the availability of such supplies shall be considered in estimating the value of pumper capacity and hose.

In grading cities where High Pressure Fire Systems furnish protection to only a part of the district considered, separate gradings shall be made for the part thus protected and for the part not protected.

The requirements given hereinafter are based in part upon the assumption that the maximum daily consumption is 50 per cent. in excess of the average, but in all cases of application the actual average consumption for the year previous shall be taken as the average consumption, and the maximum consumption for any 24 hours in the past 3 years taken as the maximum consumption, unless conditions have so changed that this maximum will not occur again. Where a system is divided into services or zones, the consumption considered shall be that of the service or zone in which the district graded is located.

In estimating required fire flow, an allowance is made for probable loss from broken connections incident to a large fire. Including this allowance, the total fire flow which should be available is as given in the table below, which is based on the formula:

$$G = 1{,}020 \sqrt{P} (1 - .01 \sqrt{P})$$

G = gallons per minute. P = population in thousands.

In all cases consideration must be given to the structural conditions as found in the city and also to the number of companies in the fire department and the amount of outside aid that would be called upon in case of a serious fire. The ratio of the total fire department pumper capacity to the fire flow required will be approximately as 2 to 3.

TABLE OF REQUIRED FIRE FLOW

Population	Required Fire Flow, Gallons per Minute for Average City.	Hours Duration	Population	Required Fire Flow, Gallons per Minute for Average City.	Hours Duration
1,000	1,000	4	28,000	5,000	10
1,500	1,250	5	40,000	6,000	10
2,000	1,500	6	60,000	7,000	10
3,000	1,750	7	80,000	8,000	10
4,000	2,000	8	100,000	9,000	10
5,000	2,250	9	125,000	10,000	10
6,000	2,500	10	150,000	11,000	10
10,000	3,000	10	200,000	12,000	10
13,000	3,500	10			
17,000	4,000	10			
22,000	4,500	10			

Over 200,000 population, 12,000 gallons a minute, with 2,000 to 8,000 gallons additional for a second fire, for a 10-hour duration.

In Residential Districts.—The required fire flow depends upon the character and congestion of the buildings. Sections where buildings are small and of low height and with about ⅓ the lots in a block built upon require not less than 500 gallons a minute; with larger or higher buildings up to 1,000 gallons is required, and where the district is closely built, or buildings approach the dimension of hotels or high value residences, 1,500 to 3,000 gallons is required, with up to 6,000 gallons in densely built sections of 3-story buildings.

Water Supply.

In grading a water supply it is assumed that its principal requirement is to deliver water in sufficient quantity to permit pumpers of the fire department, attached to hydrants, to obtain an adequate supply. To overcome friction loss in the hydrant branch, the hydrant and the suction hose, a minimum water pressure, during flow, of 20 pounds is required, except that a minimum of 10 pounds is permissible in districts having no deficiency in Items 28 and 31, and having all hydrants provided with at least one nominal 4½-inch outlet.

Higher sustained *pressure* is of value as permitting direct supply to automatic sprinkler systems and building standpipes and hose systems, and as maintaining a water plane such that no portion of the protected area is without water.

For communities requiring not more than 2500 gallons a minute fire flow and with not more than 10 buildings exceeding 3 stories in height, a pressure of 60 pounds, and for other places a pressure of not less than 75 pounds, maintained under fire demand, will permit the fire department to develop effective streams direct from hydrants, providing hydrant spacing is such as to give short hose lines; in thinly built residential sections and in village mercantile districts of comparable hazard and without buildings exceeding 2 stories a pressure of 50 pounds may be satisfactory.

The value of higher pressures is recognized in Items 6c, 20, 21, 22 and 23 of Water Supply and Items 13 and 14 of Fire Department.

Where credit for streams direct from hydrants is given under Item 13, Fire Department, Items 8, 9, 11 and 16 of Water Supply shall be with respect to the ability to deliver water at direct hydrant stream pressures; except that if pumpers are available in the fire department the grading of these items may be on the basis of quantities available at 20 pounds, but not to exceed a fire flow, at times of maximum daily domestic consumption, equal to ⅓ the fire flow required, assumed as waste, plus the available pumper capacity in the fire department.

1. Appointment. — Employees on municipal systems to be under adequate civil service rules, properly administered, with tenure of office secure. Long tenure of office and an efficient organization may be considered the equivalent.

Appointments not under civil service for indefinite terms:

Use 1/10 Deficiency Scale.

2. CHIEF EXECUTIVE (Superintendent or Chief Engineer) to be qualified by experience, preferably supplemented by education, to fill the office efficiently.

Not qualified:

Use 1/10 Deficiency Scale.

3. RECORDS AND PLANS of the physical structures and operation of the system to be complete, in convenient form, safely filed, in duplicate, indexed and up to date.

Incomplete records or plans:

Use 1/5 Deficiency Scale.

4. EMERGENCY PROVISIONS. Emergency crews shall either be on duty at all times or quickly available; suitable transportation, and necessary tools, shall be provided. Extra pipe and fittings and the necessary construction equipment shall be readily available. At least one responsible employee familiar with the system shall respond to all fire alarms in mercantile districts and to second alarms elsewhere.

Inadequate emergency provisions:

Use 1/10 Deficiency Scale.

5. ALARMS OF FIRE. In any system some means of receiving alarms of fire is essential to fire service. These may be by outside alarm, by telephone or by fire alarm. Where special operations are required, such as the calling of operators, putting additional equipment in service, operating emergency or special valves, or raising pressures, alarm service shall be equivalent to that to a fire station.

For deficiency in fire alarm service, based upon importance and need, and point at which alarms are received, but in no case less than 25 per cent. deficiency where alarms are received by telephone only, and not less than 33 per cent. where not received.

Use 1/5 Deficiency Scale.

6. ADEQUACY, AS REGARDS CAPACITY, OF SOURCE OF SUPPLY AND SUPPLY WORKS, TO DELIVER REQUIRED SUPPLY TO THE DISTRICT CONSIDERED—In this item there must be considered the normal ability of the source of supply, including impounding reservoirs, and of each part of the supply works to maintain maximum consumption demands and fire flow. Filters may be assumed as capable of 25 per cent. overload capacity. In considering the source of supply, if shortage of supply is intermittent, apply deficiency under Item 7.

With supply from wells the absolute minimum supply available under extreme dry weather conditions should not be taken as the measure of the normal ability of the source of supply. Under both items *a* and *b* the normal or average capacity of wells during the most favorable nine months period would be the average to use. To cover the deficiency under dry weather conditions or when some well is being overhauled an application should be made under Item 7.

Under Supply Works, which includes intakes, suction lines, pumps, boilers, stacks, air compressors, filters, and force or supply mains, storage shall be assumed as offsetting only deficiency in ability to deliver fire flow, and not deficiency in ability to meet consumption demands, except that where storage is relatively large and records indicate no shortage in domestic consumption, it shall be assumed that no deficiency exists, if fire flow could be obtained for the duration of time, corresponding to the required fire flow, as given below.

Fire Flow Required, Gallons a Minute	Hours Duration
Less than 1,250	4
1,250 to 1,499	5
1,500 to 1,749	6
1,750 to 1,999	7
2,000 to 2,249	8
2,250 to 2,499	9
2,500 and greater	10

In considering the deficiency under this item, results obtained at fire flow tests in the most favorable location in the district shall be used as a basis in making calculations as to the probable deficiency under maximum consumption conditions, due allowance being made for any emergency supply. (See page 12.) The extent of deficiency of each part of the supply works must be considered and the percentage of deficiency of the most serious used.

The pressure at which 10 per cent. of the required fire flow can be delivered is assumed as a measure of the value of pressure to fire protection and is applied in all cases under Item 6*c*.

a. For average domestic consumption and fire flow: Use 2 times Deficiency Scale.

b. And add for maximum domestic consumption and fire flow: ½ Deficiency Scale.

c. Apply 10 points for each 10 pounds pressure below 60 pounds at which 10 per cent. of required fire flow, but not less than 200 gallons, is available at the weakest place in the district considered.

7. RELIABILITY OF SOURCE OF SUPPLY.—The effect on adequacy must be considered for such items as frequency and duration of droughts, physical condition of intakes, danger from earthquakes, floods, forest fires, ice dams and other ice formations, silting-up or shifting of channels, absence of watchmen where needed, or injury by physical means; also for reliability of well supply, including clogging, salinity and need of periodic cleaning. Where supply is from wells consideration must be given to the absolute minimum capacity of the wells under the most unfavorable conditions and to the length of time the wells would be below maximum consumption demands; also whether this condition applies every year or only at infrequent intervals; it must be remembered that some water is available and that the most extreme conditions are not as bad as a total interruption of the supply, as would be the case in the breaking of a dam or shifting of a channel. Frequent cleaning of reservoirs, on which fire supply is largely dependent, may be considered as affecting reliability. No feature of the supply is to be considered which is covered by requirements hereinafter given.

Use 2 times Deficiency Scale in proportion to degree of unreliability.

8. RELIABILITY OF PUMPING CAPACITY on which supply is dependent, shall be on the following basis:

Pumping capacity must be such, with the two largest pumps out of service, as to maintain maximum consumption and fire flow at required pressure. For cities requiring less than 5,000 gallons fire flow, the relative infrequency of fires is assumed as offsetting in part the probability of a serious fire occurring at times when pumps are out of service and allowance will be made accordingly.

Where storage is provided, its ability to maintain supply shall be considered, with one pump and two pumps out of service. To have no deficiency, pumps and storage must be able to provide fire flow for 4 to 10 hours during a period of 5 days' maximum consumption.

Where capacity remaining, alone or in connection with storage, does not equal maximum domestic consumption, only such an amount as is available at desired pressure may be allowed; full credit will be given for pumps normally used for other service if capable of delivering against fire pressure and so connected as to be available. Capacity of pumps shall be considered on basis of present capacity, with proper allowance for loss due to condition. A centrifugal pump is not to be credited with capacity greater than that obtained when pumping against full pressure necessary to maintain credited fire flow, in conjunction with the flow available from storage.

In cases when adequacy and reliability of supply is also dependent upon low-lift pumps, compressors, electric generators or other separate and distinct power units, each group performing a given function must be considered separately and deficiency applied, and the points added.

If, as in a system supplied by deep well pumps, the deficiency in adequacy of supply and pumps is equal, assume it as due to supply, and do not use required quantity as basis in this item.

a. Use full Deficiency Scale for deficiency on basis of one unit out of service.

b. Add ¼ Deficiency Scale for deficiency on basis of two units out of service.

Reduce points of deficiency for b 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

9. BOILER CAPACITY, with a reserve of one-fourth the entire capacity, and in any case at least one boiler, must be sufficient to operate all machinery and the pumps required, as determined under Item 8, to maintain maximum consumption and fire flow, with allowance made for storage. Application must be made separately to each independent steam plant on which supply is dependent, including electrical generating plant, and the points of deficiency added.

Normally, there must be sufficient boiler capacity kept under at least ½ required steam pressure, to deliver full requirements, in connection with storage, for a period of 2 hours.

Capacity of boilers should be based upon maximum output in pounds of steam, rather than nominal horse-power, and consideration will be given to limitation of stock, forced draft and feed rate of burner or stoker.

a. Use ½ Deficiency Scale for deficiency in boiler capacity.

b. Add ¼ Deficiency Scale for deficiency in boilers under steam.

Reduce points of deficiency for b 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

10. CONDITION, ARRANGEMENT, AND RELIABILITY OF PLANT EQUIPMENT.—Plant equipment is a general term embracing generally the mechanical features of pumping station, purification works, electric generating stations, and other parts of the system not considered under Items 7 and 17. Consideration under this item will include the operating force, which must be competent and adequate to maintain fire service. The various forms of prime movers, such as steam or water power units, electric motors and internal combustion engines, and different types of pumps, boilers, filters and other equipment, are considered of approximate equal worth; their dependability is largely influenced by design and construction and the maintenance received.

Service record in the plant under consideration and in similar plants shall be considered and the actual operating conditions

observed. Reserve or spare equipment, which has been credited under other items, will be considered as in poor condition if records are not available indicating recent satisfactory operation or test.

Plants must be well arranged with the view to effective operation. Ease and facilities for repair work, danger of flooding by broken piping, injury by water spray, absence of semi-annual inspection of boilers or other pressure vessels, dependence upon common non-sectionalized electric busses, poor arrangement of piping not applied under Items 16 or 17, single source operation of valves or other devices necessary for fire service are all features which must be considered.

This item includes reliability of the purification plant as influenced by the putting out of service of one filter bed, the lessening of filter capacity by turbidity or other conditions of the water, the need of cleaning basins, and the dependability of power for operating mixers and other appurtenances.

Deficiency to be applied for each station on which service depends, including electric generating station.

On basis of capacity affected and degree of unreliability. A deficiency may apply under this Item even though there is no deficiency under Items 8, 9 and 11. Use full Deficiency Scale.

11. FUEL AND ACCESSORIES FOR THE TRANSMISSION OF POWER. —A minimum of 5 days' coal supply shall be provided; where long hauls, condition of roads, climatic conditions or other causes make a longer interruption of delivery possible, a greater storage shall be provided. Gas supply shall be from two independent sources, or from duplicate gas producer plant with a storage of at least 24 hours' gas supply. Oil supply shall be from underground storage of at least 5 days' capacity, with force feed to engine or boiler. Unreliability of gas or oil supply to boilers may be lessened by proper provisions for the use of other fuel. Water for power shall equal at all times that necessary to meet maximum requirements (or other power provided to equalize deficiency) and shall have proper flood and ice control.

Steam piping (or gas or oil piping with internal combustion engines or to boilers) or boiler-feed lines or electric transmission

lines, or air lines to wells, shall be so arranged that a failure in any line, or the renewal of a valve, transformer, high-tension switch, oil pump, boiler feed pump or injector would not prevent maintaining, in connection with storage, fire flow for 4 to 10 hours during a period of 2 days' maximum domestic consumption. Overhead electric lines introduce a degree of unreliability which may be in part offset by storage; consideration in connection with such lines shall be given to number and duration of wind, sleet and snow storms, character of poles and wires, character of country traversed, effect of forest fires, lightning protection provided, and ease of and facilities for repairs; the use of the same transmission line from the transformer or switch board by other plants introduces a hazard of short circuit or prior use of power and may be considered as the equivalent to the use of overhead lines in applying the schedule. Deficiency to be applied to each station on which service depends, including electric generating station.

a. Adequacy and reliability of fuel:
   Use ¼ Deficiency Scale.

b. Number and capacity of electric lines, including high-tension switches and transformers:
   Use ¼ Deficiency Scale.

c. For overhead electric lines, add in proportion to unreliable service and installation, Full Deficiency Scale, and increase points of deficiency 1 per cent. for each mile length of overhead line on which normal service depends.

d. Number and capacity of steam lines, boiler-feed, gas or oil pipes, or valves, including boiler-feed pumps or injector and oil pumps:
   Use ¼ Deficiency Scale.

e. Number and capacity of air lines:
   Use ¼ Deficiency Scale.

Item a may apply in addition to b, c, d or e.

Under Items b, d and e if reliability of supply is dependent on two or more of the power transmission features, each shall be considered separately and a deficiency applied. Under Item d only the most serious deficiency will apply where they pertain to the same boiler plant. In considering b, d and e,

the ease of making repairs and the facilities available may justify a reduction of not more than 50 per cent of the deficiency, unless storage for the fire flow period is available when a 75 per cent reduction can be made.

Reduce total points of deficiency for a, b, d and e 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

PUMPING STATION:

12, 13, 14 and 15. Pumping stations and other portions of the plant shall contain no combustible material in their construction; otherwise an automatic sprinkler equipment shall be provided; outside hydrants and hose, inside standpipes and small hose, and chemical extinguishers shall be provided. Public fire station, if within ¾ mile, shall be considered as giving about ½ protection. If pumping station is not fireproof, the several sections, particularly any with high-potential generating equipment, shall be separated by parapeted fire walls and openings protected by at least a single standard fire door or wire glass in metal frames. Station shall be protected against exposures. Electric wiring shall be in accordance with the National Electrical Code and all internal hazards safeguarded.

Note.—Under Items 12 to 15, inclusive: Where 2 or more Stations are not dependent upon each other for operation, apply deficiency to the station of predominating importance. Reduce points of deficiency by the proportion that the capacity of the other stations is to the total required, then add a deficiency charge for these other stations in the proportion that the amount of their capacity necessary to maintain total required flow, in conjunction with that available from the station of predominating importance, is to the total required. Where stations are dependent on each other for operation, apply deficiency to each.

Under each of Items 12 to 15, inclusive: For each day's maximum consumption storage, deduct 1/10 the points of deficiency.

12. Construction:

Apply in proportion to susceptibility of damage from fire: Use ⅓ Deficiency Scale.

13. Insufficient fire protection, other than sprinklers:

Use 1/20 Deficiency Scale.

14. Hazards:

Use ⅓ Deficiency Scale.

15. No protection against exposure:

Use ⅛ Deficiency Scale, unless building is largely of frame construction or with combustible roof covering, in which case use ¼ Deficiency Scale.

16. RELIABILITY OF SUPPLY MAINS AS AFFECTING ADEQUACY. —Under this heading will be included any and all pipe lines or conduits on which supply to the distribution system is dependent; suction or gravity lines to pumping station, flow lines from reservoirs, force mains, etc., are included and a system may have one or all of these as part of it. Under Item 6, the adequacy of these lines under normal conditions has been considered. Consideration must be as to greatest effect on maximum consumption and fire flow at required pressure that a break could have. If remaining mains and storage cannot deliver even maximum consumption, allow for only that amount available at required pressure. In applying, all mains which deliver from a source of supply or of storage to the principal district must be considered. Aqueducts, of good design and of substantial construction, such as masonry or concreted steel, if so installed as not to be deficient under Item 17 following, shall be considered sufficiently dependable as not to require duplication, and no application will be made as to the effect of a possible break.

The effect of a break in suction or discharge headers, lack of by-passing or poorly gated by-pass or arrangements at any reservoir, filter, etc., poorly arranged cross-connections, etc., must be considered; also features which would tend to cause or prevent an interruption of service, such as length of line, and two or more lines from the same or different sources or from storage.

Under the assumption of the most serious break, the deficiency may be considered as offset if the remaining mains, from the source of supply and storage, can provide fire flow for 4 to 10 hours during a period of 5 days maximum consumption.

Deficiency for each individual possible break must be considered, and charge made for the case giving the maximum total number of points, including the increase due to length of line; if at two or more points, as in a low-lift discharge and in a high-lift discharge, a break produces essentially the same per cent. of deficiency the length used shall be the sum of the individual lengths.

For cities requiring less than 5,000 gallons fire flow, the relative infrequency of fires is assumed as offsetting in part the probability of a serious fire occurring at times when a main is out of service and allowance will be made accordingly.

For maximum effect on maximum domestic consumption and fire flow of any single break in any main, apply ½ Deficiency Scale, and increase the points of deficiency by 1 per cent. for each 1,000 feet of main in which a single break would produce this maximum effect.

Reduce points of deficiency 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

For supply lines not under vacuum and entirely on private right of way, decrease the above total by 10 per cent. for each 10 pounds pressure less than 50 pounds, for the maximum pressure carried on the lines.

17. RELIABILITY OF INSTALLATION OF SUPPLY MAINS.—Must be in good condition and reliable; cast-iron, wrought-iron, steel, asbestos cement, wood-stave and reinforced concrete pipe lines and masonry and concreted steel conduits have been found satisfactory in various places and under certain conditions; service records and general conditions must be considered.

Mains shall be so laid as not to endanger each other, and their failure at stream crossings, railroad crossings and other points where physical conditions are unsatisfactory shall be guarded against; they shall be gated about once a mile and be equipped with air-valves at the high points and blow-offs at the low points.

The general arrangement of valves, specials and connections at cross-overs, intersections, reservoirs and discharge and suction headers must be considered, with the view to quickness in shutting down breaks; the need of check valves on supply or force mains and other arrangements to prevent flooding stations or emptying reservoirs at time of a break in a main must be considered, also of relief valves or surge chambers on long lines. Absence of suitable material or equipment and ease of repairs shall be considered. The repair of a valve which will result in reduction of supply would be a deficiency which might be considered as moderately unreliable if resulting in total interruption; but no deficiency shall be applied for a valve controlling flow in that part of a line for which deficiency has been applied under Item 16. Increasing pressures for fires more than 25 per cent. is considered as increasing liability of breaks.

If more than one main and conditions do not affect all, apply in proportion to the carrying capacity affected, and the degree of unreliability. A deficiency may apply under this item even though there is no deficiency under Item 16.

Use ½ Deficiency Scale in proportion to degree of unreliability.

18. ARTERIAL SYSTEM.—In connection with the supply mains, arteries and secondary feeders shall extend throughout the system. These feeders shall be of sufficient size, considering their length and the character of the sections served, to deliver fire flow necessary for the district, shall be frequently spaced (about every 3,000 feet) and looped; practical dependence of large sections on single mains constitutes a deficiency. Basis of deficiency applied to be the results of fire flow tests and general consideration of the arrangement. When mains have been cleaned, but rapid tuberculation may be expected, a deficiency may be applied although none now exists.

Inadequate Arterial System:
Use ½ Deficiency Scale.

19. INSTALLATION.—Mains of the arterial system shall not be laid across filled ground, and shall have special construction at railroad crossings and near bridge abutments, and shall be so gated that not more than ¼ mile within the distribution system will be affected by a break. All mains shall have sufficient cover to prevent freezing, with a minimum cover of 2 feet to prevent injury from traffic.

Installation of Mains:
Use 1/5 Deficiency Scale.
Note.—Consideration not to be given to conditions already covered by Item 17 above.

20, 21, 22 and 23. MINOR DISTRIBUTERS AND GRIDIRON SYSTEM.—Six-inch to be considered the minimum size satisfactory for hydrant supply in residential districts; to be closely gridironed with 6-inch cross-connecting mains at intervals not exceeding 600 feet, or where initial pressures are high a satisfactory gridiron may be obtained by a liberal per cent. of larger mains cross-connecting the 6-inch at greater intervals; in new construction, 8-inch should be used where dead ends and poor gridironing are likely to exist for some time, and 6-inch only where blocks are 600 feet or less in length. In high value districts, the minimum size to be 8-inch with cross-connecting mains at distances as given above; 12-inch and larger mains to be on the principal streets and for all long lines not cross-connected at frequent intervals.

20. Effect of Small Mains in High Value District Considered:

For deficiency in fire flow in the part of the district where the least supply is available, whether due to weakness in the system or low pressures.

Use full Deficiency Scale.

Per cent. of deficiency to be based on fire flow obtained at strongest point in district, except where this exceeds required fire flow, in which case the latter should be used as basis. In all cases comparison shall be on the basis of the flow available for pumper supply.

21. Small Mains in the Distribution System:

a. For per cent. of 4-inch or smaller mains supplying hydrants:

Use ½ Deficiency Scale.

b. Add 1 point for each mile of 4-inch or smaller pipe.

Do not include areas in which block fronts have less than 1/5 the lots built upon, or which are separated from the main system by a natural barrier or considerable open space, nor in larger cities areas outside a 5-mile radius of the district considered. Tuberculated 6-inch pipe having only the capacity of 4-inch new pipe may be included as 4-inch. Do not exceed a total of 200 points.

Reduce the points of deficiency (sum of a and b) 5 per cent. for each 10 pounds average normal static pressure above 20 pounds. Normal static pressure to be assumed as that carried normally at time of fire.

22. Dead Ends: 6-inch and smaller pipe dead ended and supplying hydrants, including dead ends at service limits, on basis of total length of pipe.

a. For per cent. of dead ends:

Use ½ Deficiency Scale.

b. Add 1 point for each mile of dead ended pipe.

Do not include areas in which block fronts have less than 1/5 the lots built upon, or which are separated from the main system by a natural barrier or considerable open space, nor in larger cities areas outside a 5-mile radius of the district considered.

Reduce the points of deficiency (sum of a and b) 5 per cent. for each 10 pounds average normal static pressure above 20 pounds. Normal static pressure to be assumed as that carried normally at time of fire.

23. Gridiron (average condition in closely built residential sections): 6-inch or smaller mains on long side of block, with 8-inch or larger cross-connections:

Apply 5 points for each 100 feet, in excess of 600 feet, average length between cross-connections.

If cross-connections are 6-inch or smaller, increase points of deficiency by 50 per cent.

Do not apply where deficiency under Item 22 exceeds 75 per cent.

Reduce the points of deficiency 10 points for each 10 pounds average normal static pressure above 20 pounds. Normal static pressure to be assumed as that carried normally at time of fire.

Where a gridiron is very irregular, due to topography or scattered groupings of houses, or fire flow tests are inadequate because of serious deterioration of carrying capacity and no application is made above:

Apply a deficiency not to exceed 50 points.

24. PIPE.—In distribution system, pipe to be of satisfactory quality and properly tested for soundness and tightness of joints. The use of pipe under pressure double that specified for the class is considered as introducing an unreliable feature, particularly where pressures are raised for fires; tests before backfilling and favorable service records of several years duration may be assumed as offsetting this defect in part. Electrolysis conditions to be studied and methods of prevention applied.

For pipe in unreliable condition, apply, depending upon location and size of pipe, ¼ Deficiency Scale.

Increase points of deficiency 2 points for each mile of such pipe.

25. CONDITIONS AFFECTING FIRE PROTECTION IN OTHER THAN THE DISTRICT GRADED.—No extensive occupied area should be subject to severe depletion of normal fire supply including supply to automatic sprinklers and standpipes, at any time. Conditions considered shall be: dependence on inadequate reserve pumping capacity, non-fireproof pumping stations and other reliability features where supply is in several services; occasional excessive hourly domestic demand when pressures are reduced and do not furnish satisfactory domestic supply; extensive hill areas depleted of water during fires in other areas; extensive areas requiring unusual operation to give adequate fire supply.

For seriousness of conditions in proportion to per cent. of area affected:

Use full Deficiency Scale.

26. GATE VALVES.—The distribution system shall be equipped with a sufficient number, so located that no single case of accident, breakage or repair to the pipe system, exclusive of arteries, will necessitate the shutting from service a length of pipe greater than 500 feet in high value districts, or greater than 800 feet in other sections, and will not result in shutting down an artery.

Spacing in high value districts:

a. For each 100 feet over 500 feet, apply 3 points.

Spacing in residential districts:

b. For each 100 feet over 800 feet, apply 1 point.

Deficiency under a and b not to exceed 50 points for each.

27. INSPECTION AND CONDITION OF VALVES.—All valves to be inspected yearly and large valves more frequently, and be kept in good condition; the presence of some valves operating in opposite direction is to be considered the equivalent of unsatisfactory condition, ranging from fair to poor, depending on the number and importance.

Gate valves not inspected regularly or in poor condition:

Use 1/10 Deficiency Scale.

28 and 29. HYDRANT DISTRIBUTION.—Shall be sufficient to give an average area served, in proportion to the fire flow, as given on page 31. Where direct streams are used, 4- or 6-way hydrants with independent gates on outlets may be assumed as two hydrants

in figuring area served. Where it is the practice of the fire department to connect two pumpers to a hydrant, those with two steamer outlets may be assumed as 1½ hydrants. Cisterns with supply connections may be counted as hydrants.

Fire Flow Required, Gallons per Minute	REQUIRED AVERAGE AREA PER HYDRANT, SQUARE FEET
1,000	120,000
2,000	110,000
3,000	100,000
4,000	90,000
5,000	85,000
6,000	80,000
7,000	70,000
8,000	60,000
9,000	55,000
10,000	48,000
11,000	43,000
12,000	40,000

28. Area served in the high value district considered:

Apply 10 points for each 10,000 square feet in excess of requirements.

The actual area of the high value district to be used in estimating the area served per hydrant, and boundary hydrants to be considered as ½ a hydrant.

Where hydrants are so spaced that portions of the district are poorly served, a deficiency shall apply even though the average area served is not in excess of that required.

29. Area served in residential and other districts:

In residential districts apply 3 points for each 10,000 square feet in excess of requirements.

Residential district to include all that area contiguous to the district considered in which block fronts have 1/5 the lots built upon, but to exclude the high value district. The charge to be applied on the above basis even though there are no hydrants in the residential district, but in no case to exceed 400 points.

Add, not to exceed 20 points, for deficiency in hydrants in manufacturing, minor mercantile, apartment and other special districts.

30. CONDITION OF HYDRANTS.—Hydrants shall be inspected in the spring and fall of each year, after use at fires during freezing weather and daily in high value districts during protracted periods of severe cold. Condition is to include proper location and setting of hydrant.

Inspection and condition:

Use 1/5 Deficiency Scale.

31 and 32. SIZE AND INSTALLATION OF HYDRANTS.—Hydrants shall be able to deliver 600 gallons per minute, with a loss of not more than 2½ pounds in the hydrant and a total loss of not more than 5 pounds between the street main and outlet; they shall not have less than two 2½-inch outlets and also a large suction connection where pumper service is necessary. They shall be of such design that when the hydrant barrel is broken off the hydrant will remain closed. Street connection shall be not less than 6 inches in diameter and shall be gated. Hose threads on outlets should conform to the National Standard. Flush hydrants, requiring chucks to be screwed on, are considered undesirable, especially in sections of the country subject to heavy snow storms, because of delay in getting in operation. Cisterns are considered as of improper type.

31. Apply deficiency on basis of number of hydrants with 4-inch connection to main, small foot valve or barrel, inadequate number of outlets or otherwise inadequate or unsuitable, but modify per centage where static pressures partially offset deficiency in size or outlet, and where hydrants are suitable except in one of the above items. If in the high value district considered, there are more hydrants than are required for proper spacing, and the small hydrants are not generally used by the fire department, use in determining the deficiency only the number of small hydrants required to make up the total number necessary for proper distribution; i. e., do not charge for the surplus small hydrants.

a. Use 1/5 Deficiency Scale for those in the high value district considered.

b. And add 1/5 Deficiency Scale for those elsewhere.

Reduce points of deficiency for b 5 per cent. for each 10 per cent. of 4-inch and smaller pipe charged for under Item 21.

32. Hydrant connections to street main:

Each 10 per cent. not gated apply 1 point.

If 26 is double that required, use double the points.

If no deficiency under 26, do not apply 32, unless hydrants on main arteries are not gated, in which case use a total of 10 points. If deficiency occurs in 26 a or b only, apply partial deficiency under 32.

FIRE DEPARTMENT

Note.—For cities with no organized fire department, no credit will be given for apparatus and a full deficiency of 1,500 points applied.

For cities of under 10,000 population having any organized fire department—volunteer, call, part paid or fully paid—application shall be made on all Items, and because of infrequency of fires, a deduction made as follows:

From the points of deficiencies applying to Items 1, 2, 4, 5, 6, 7, 14, 17, 19, 25, 27, 33 and 34; deduct 10 per cent. for each 1,000 population below 10,000 population.

1. OFFICERS.—There shall be a chief, and for over 2 existing companies, an assistant or deputy chief, who shall be in charge in the absence of the chief. For over 12 companies there shall be also a chief officer (Battalion or District Chief) on duty at all times, for each additional 8 companies; such officers shall not be credited in the company strength. There shall be sufficient company officers to have one on duty at all times with each pumper, hose or ladder company, or each combined company. Call officers, *i. e.,* officers who receive some pay for services, but do not devote their entire time to fire department duty, and active volunteer officers shall each be considered as equivalent up to ½ of a full paid officer.

a. Use 1/5 Deficiency Scale for chief officers.

b. Add 1/5 Deficiency Scale for company officers.

2. OPERATORS.—There shall be a sufficient number of competent operators (engineers and chauffeurs) so that one shall be on duty at all times for each existing pumper or motor-driven apparatus. Special training and examination shall be required and incompetency shall be considered as equivalent to deficiency in numbers.

Use ¼ Deficiency Scale.

3. QUALIFICATIONS OF CHIEF OFFICERS.—Chief officers shall be experienced in fire service.

Not qualified:

a. Use 1/10 Deficiency Scale for chief.

b. Add 1/20 Deficiency Scale for other chief officers.

4. CHIEF'S TENURE OF OFFICE.—Chief shall hold office for an indefinite term and be removable only for cause after public trial.

Chief removable without cause, 10 points.

5. APPOINTMENT AND PROMOTION OF OFFICERS.—Officers' appointment and promotion shall be based on examination, seniority and record, under civil service rules with tenure of office provisions.

Method of appointment and promotion of officers:
Use 1/20 Deficiency Scale.

6. ENLISTMENT.—Privates' enlistment shall be under civil service rules and based on physical and mental examination, with satisfactory age, weight and height limits; permanency to be only after a satisfactory probation of 6 months.

Method of enlistment of privates:
Use 1/10 Deficiency Scale.

7. RETIREMENT.—Full paid members shall be retired at the age of 62, unless unusually efficient at that time; proper and ample means shall be provided for pensioning men for long service or disability.

Provisions or enforcement for retirement:
Use 1/20 Deficiency Scale.
Not to apply for age limit if no member is over 55 years of age.

8. APPARATUS REQUIRED FOR PUMPER AND HOSE COMPANIES.—The amount of apparatus in service and regularly responding to alarms should be sufficient to properly protect the city and shall be on the basis of companies required, it being assumed that each pumper or hose company will be provided with a hose carrying vehicle, and that in cities of over 100,000 population one-half the pumper companies that should attend any first alarm in high value districts will be provided with a pumper and a separate hose wagon or a second pumper, which acts as a hose tender; other pumper companies may have only a combined pump and hose wagon.

Every properly equipped piece of apparatus regularly responding to alarms shall be considered as a separate company, whether

so organized or not, except that to be considered as a pumper company there must be an accompanying hose wagon or hose must be carried on the pumping equipment. Apparatus manned by the off-shift on a first alarm shall be considered as in service.

When one piece of equipment carries 500 feet or more of hose, a 40-foot or longer extension and at least 4 other ladders, including 2 roof ladders, grade as a hose company, or as a pumper company if provided with a pump, if necessary to reduce deficiency under Item 8, and allow credit as ½ a company under Item 9, but allow credit as for a full ladder company under Item 10. If an adequate number of hose or pumper companies, assume as a ladder company under Item 9.

Apparatus is assumed to be automobile. Where hand drawn, towed, or horse drawn a deficiency shall apply under Items 15 and 30e.

P = population in thousands.

For cities under 50,000:

Apparatus* needed for Pumper or Hose Companies = 0.85 + 0.12 P.

For cities having population of 50,000 to 200,000:

Apparatus* needed for Pumper or Hose Companies = 3.4 + 0.07 P.

For cities having population in excess of 200,000, the number of Pumper or Hose Companies depends on distribution, as covered by Item 10, and on the ability to quickly concentrate apparatus in high value districts or to handle two simultaneous large fires without leaving all other sections of the city unprotected.

Note.—In certain cities a number in excess of the above will be required, depending on the structural conditions found in the city. Where the topography and general layout of the city require, for proper distribution, a greater number of companies than determined by the formula, deficiency will be applied under Item 10.

*Whole numbers to be used; for fractions between 0.4 and 0.7, use smaller or larger whole number, according to character of city.

Where protection is furnished to territory not within the corporate limits the total population served shall be used as the basis; if the number of companies is sufficient, but the response results in serious reduction in protection to the district graded, application shall be made under Items 30c and d and Item 31, and where there are community groupings of buildings, of such extent or character that additional companies will be required, application will be made under Item 10, with corresponding application under Items 11, 13, 18 and 19.

In cities almost solely residential in character, such as suburbs in metropolitan districts, or where the city has small local high value centers needing less protection than the formula for companies calls for, the estimate will be based on the population corresponding to the fire flow believed necessary, as used in Item 6, Water Supply, except that where such cities have congested shingle-roof frame districts, or extensive manufacturing or other high value sections requiring more water than the district graded, additional companies must be provided to protect the city in case of a second fire.

The number of companies in service shall be assumed as increased by companies available as outside aid, where by regular assignment the response of such companies is provided for to the district considered or to fill in and where the total number of companies is equal to the number required for the combined population of the place graded and that rendering aid; such increase to be made on the basis of one outside aid company equaling ½ a company in service, but not to exceed a total increase of ⅓ the total number of companies required. Where adequate provision is not made for mutual aid from outside companies, the full number of companies available within 30 minutes may be allowed as a credit equal to ⅓ the points which this number decreases the deficiency in actual companies; if hose couplings are not interchangeable or adapters provided, this credit shall equal only ¼ the points.

Use full Deficiency Scale for Numerical Deficiency of Apparatus.

9. APPARATUS REQUIRED FOR LADDER COMPANIES.—In cities having 5 buildings of a height corresponding to 3 stories or

higher, there shall be one ladder company; in cities over 20,000 population, the number of ladder companies shall equal 1 + 0.03 P.; for cities of over 200,000 population, the number of companies will depend upon distribution as covered by Item 10; the population used is actual and not that corresponding to the fire flow. Where no ladder company is required, application shall be made under *a* below for deficiency in ladder equipment on other apparatus to reach the roof of buildings. An aerial ladder must be provided in a district where 5 buildings are 4 stories or higher and one ladder truck in 5 shall be aerial; to be classed as an aerial, the principal ladder shall be attached to the truck frame, be of sufficient length for use on the higher buildings and be readily operated by not more than two men. In applying *a* and *b* below, a fully equipped truck in reserve ready for service may be considered as ½ value of a truck in service. Credit may also be allowed for outside aid as under Item 8. A pumper-ladder truck which has been credited as a pumper under Item 8 will be considered as only ½ a ladder truck.

A reserve ladder truck shall be provided for each five, or fraction thereof, required; where the number of ladder trucks in service exceeds the number required or ladder trucks are in service in territory where short ladders carried on hose wagons are sufficient, these may be considered as reserve.

For per cent. of numerical deficiency:

a. Use 1/3 Deficiency Scale for ladder trucks in service.

b. Add 1/10 Deficiency Scale for deficiency in aerial trucks.

c. Add 1/10 Deficiency Scale for reserve trucks.

10. DISTRIBUTION OF COMPANIES.—Companies shall be provided and so distributed as to assure quick response of the first due company; also that, for serious fires in high value districts, the necessary number of companies are promptly available, and, in the larger cities, that simultaneous fires can be handled. The location of values, the topographical conditions, traffic congestion, and the number and extent of runs shall be taken into consideration. To accomplish quick response of the first due company, no point in any high value district shall be more than ¾ mile travel distance from a pumper or hose company or a pumper-ladder company, nor more than one mile from one providing adequate

ladder service; in residential areas the requirements are respectively 1½ miles and 2 miles for closely built sections, and up to 3 miles for each class of service in areas where buildings are scattered.

The distribution shall also provide for ready concentration of companies to serious multiple-alarm fires in any high value district and any area where the life hazard is severe; such concentration shall not strip nearby areas of protection for a second fire. In general this will require, for places of approximately 100,000 population, a minimum of 4 pumper companies within 1½ miles travel distance of the center of the congested value district; for cities of 200,000 population and over, approximately 16 pumper companies must generally be available within 3 miles of the congested value district.

If the additional companies required under Items 8 and 9 are sufficient to give proper local distribution, do not apply deficiency under this Item.

Where a company is properly located to give protection to the territory included in its running district but is not provided with apparatus of proper size or type; for instance, is equipped only with a hose wagon when pumping equipment is needed for local protection, or has a service truck where an aerial is required, a deficiency applies under this item, unless sufficient equipment of proper type will be provided by removing deficiency now existing under Items 9*b* or 13.

Apparatus not of proper type should, however, not be considered as serious as the lack of a company. In general, the deficiency as applying to apparatus would be ⅓ to ⅔ of that due to the lack of a fire station, men and apparatus, all of which are commonly considered as comprising a company.

10. For per cent. of numerical deficiency of companies, or of companies or apparatus not properly located.

- **a. Use ½ Deficiency Scale for pumper or hose companies in the district considered.**
- **b. Add ¼ Deficiency Scale for pumper or hose companies in other districts.**
- **c. Add ¼ Deficiency Scale for ladder companies in the district considered.**
- **d. Add 1/10 Deficiency Scale for ladder companies in other districts.**

11 and 12. MAINTENANCE OF COMPANIES.—The number of men provided and the provisions made for vacations, sickness and details shall be such as to maintain manning of each company as follows:

COMPANIES	Least Number of Men on Duty.
Within or near High Value Districts:	
Pumper Company	7
Hose Company	6
Aerial Ladder Company	7
Service Ladder Company	8
Pumper-Ladder Company	10
In Other Districts:	
Pumper Company	5
Hose Company	4
Aerial Ladder Company	6
Service Ladder Company	6
Pumper-Ladder Company	8

In places of less than 50,000 population, consider as high value hose or pumper companies the number necessary for first alarm as required in Item 30, regardless of the location of the others, or use for each company in the department a manual strength equal to one less than that for high value companies. Where an aerial truck is not required (See Item 9), consider ladder companies on 6-man basis, regardless of location.

NOTE A. The above strength of pumper companies is based upon the use of automobile pumpers; one man more must be added in companies having steam fire engines.

Note B. If drivers do not perform fire duty the above strength of companies affected must be increased by one. In cities of over 100,000 population the chiefs' drivers should act as aides to the chiefs and shall not be considered in the company strength.

Note C. Where high pressure fire systems are in use and a man is detailed to remain at the hydrant, strength of hose companies in the district served must be increased by one.

Note D. In estimating the total available strength of the department under Item 11, and of the high value companies, under Item 12, deductions shall be made for the average number of men absent during the vacation period and the average number of men

sick or incapacitated, for whom substitutes are not provided, and for men at meals or detailed to other duties such that they can not respond with the apparatus. No deductions shall be made for company members making inspections in their respective running districts.

Note E. Where emergency, rescue, or auxiliary squads, or companies equipped only with small-stream appliances, respond to alarms and remain to aid other companies the manual strength of these companies may be assumed as offsetting by one man the deficiency in other companies, the number of companies affected in each district considered being the same as the strength of the squad during the time when the strength of the other companies is a minimum.

Note F. In departments having call or volunteer members, with tappers in houses and places of business or sufficient tower bells, horns or whistles, four call or eight volunteer members, on basis of average number responding to alarms, may be considered as equivalent to one full paid member, up to ⅓ the least number required to be on duty at all times for existing companies. Volunteer members receiving pay for fire service shall be considered on call basis. Call or volunteer members sleeping at fire stations may be considered as the equivalent of paid men in estimating the night strength.

Credit may be given for paid men off duty, on the same basis as call men, if provision for notification is ample and the regulations require them to respond during meal periods, and on time off.

Note G. For outside aid companies regularly assigned in the running card and assumed under Item 8 as the equivalent to companies in service, ½ the combined least number of men on duty, but not to exceed ⅓ the required company strength when the aiding company is manned by volunteers, will be assumed as the strength of the companies thus allowed. For outside aid companies for which adequate provisions for response have not been made, the actual least number of men will be used in estimating the credit to be allowed.

When, in the city being graded, the companies are manned by volunteer or call men and the membership is large, greatly exceeding the number assumed as equal to ⅓ the number of paid men

required, there is no actual benefit to manpower by response of other volunteer or call companies as outside aid; under these conditions no credit will be allowed for this outside aid, except for such full paid men as respond with the outside aid. Credit may, however, be allowed for outside aid apparatus under Items 8 and 9.

11. For deficiency in total company membership of the department, based on the least number of men required to be on duty at all times with the existing companies and the added companies required under Items 8 and 9, and under Item 10, if by relocating companies adequate distribution cannot be obtained.

    a. For minimum strength in the day time:
    Use full Deficiency Scale.

    b. For minimum strength at night:
    Use full Deficiency Scale.

    Deduction may be made for outside aid available within 30 minutes, for which no adequate assignment of response is made, a credit equal to 1/3 the points which the combined least number of men on duty in the companies thus available decrease the deficiency in men.

12. Strength of pumper, hose and ladder companies (minimum usually responding) within or near the high value district considered:

a.	Average	1 man	deficient.	10
b.	"	2 men	"	20
c.	"	3 "	"	40
d.	"	4 "	"	60
e.	"	5 "	"	80
f.	"	6 "	"	100
g.	"	7 "	"	125

Where ladder service is required, but is not provided by a separate company, or where sufficient companies are not readily available to give the required first alarm response, the comparison shall be on basis of required men for companies required as against the actual number of men responding on first alarm, divided by the required number of companies.

Men here covered by Notes E and F may be credited, but only up to the equivalent of 1/3 the manpower required, and only if responding on first alarms.

13. PUMPER CAPACITY. — There must be provided a total pumping capacity equal to ⅔ the required fire flow.

In cities of over 200,000 population, and requiring fire flow for two simultaneous fires, pumper capacity must be provided equal to ⅔ the total fire flow required for the district.

In cities where the fire flow required in the high value district is less than that corresponding to the population, but there is a residential or industrial district of large extent and high conflagration hazard, the pumper capacity required shall be on the basis of a fire flow of not less than 2,000 gallons in addition to the amount necessary to protect the high value district, to provide protection for a simultaneous second fire.

Where fire streams are available in the district considered from a High Pressure Fire System (for description see page 74), its capacity shall be considered as pumper capacity, except that if residual pressures are less than 250 pounds, actual pumper capacity shall still be provided as given in the table on page 44.

In estimating pumper capacity available, reserve pumpers, or pumpers from other cities for which a regular running card assignment is made, either to respond to the district considered or to fill in for other companies, or fire-boats, in conjunction with fire-boat lines, or pumper on other apparatus not credited under Item 8, shall be considered at ½ their actual capacity, as offsetting delay in getting into service, but not to exceed ⅓ the total pumper capacity required. Where adequate provision is not made for mutual aid from outside companies, the full pumper capacity available within 30 minutes may be allowed as a credit equal to ⅓ the points which this capacity decreases the deficiency in actual pumper capacity; if hose couplings are not interchangeable nor adapters provided, this credit shall equal only ¼ the points.

Capacity of pumpers to be that obtained at tests corresponding to those covered by the purchase specifications, but no credit shall be allowed in excess of the rated capacity. Where no test capacities are available, no engine to be considered as of more than 80 per cent. of its rated capacity.

Deficiency in pumper capacity may be offset in whole or in part by the ability to obtain fire streams direct from hydrants,

from the same system (domestic) from which pumpers take supply. This credit shall be for the excess fire flow, over the total available pumper capacity, which is obtainable, for 4 to 10 hours, at direct hydrant stream pressure, as determined by fire flow test on the system at the weakest place in the district considered. Where hydrant spacing exceeds the following figures the amount of fire flow obtained shall be reduced by 10 per cent. for each 10,000 square feet in excess of the following spacing:

For a credited fire flow at hydrant stream pressure, Gallons a Minute	Required average area served per Hydrant, Square Feet
1000	100,000
2000	85,000
3000	70,000
4000	55,000
5000 or over	40,000

In no cases shall credit for direct hydrant stream from a domestic system be in excess of the percentage given in the following table.

Maximum Per Cent. of Credit for Fire Flow, at Corresponding Pressures for Direct Hydrant Streams.

Residual Pressure of			Number of 4-Story and Higher Buildings in District Considered:
90 Pounds:	75 Pounds:	60 Pounds:	
100	100	90	0- 5
100	100	80	6- 10
100	90	0	11- 20
100	85		21- 30
90	80		31- 50
85	70		51- 75
75	50		76-100
67	33		101 or more.

No pumper capacity required where full fire flow is available at 150 pounds and no building exceeds 10 stories in height; for pressures intermediate between 90 and 150 pounds, proportional pumper capacity is required.

For total pumper capacity: i. e., for full tested capacity of pumpers in service; ½ tested capacity of reserve pumpers; ½ tested capacity of outside aid pumpers regularly responding. Credit also supply from high pressure fire systems, and ½ supply from fire boat lines.

Use 1½ times Deficiency Scale.

Deduct for fire flow available, at the weakest point in the district considered, direct from hydrants at required pressures for effective streams, according to the following:

To determine the flow available for which credit is allowed, correct actual flow obtained at required pressure by 10 per cent for each 10,000 square feet excess hydrant spacing, then deduct the total allowed pumper capacity. The per cent of credit allowed must not exceed the percentage indicated in the table on page 44 based upon the number of 4-story and higher buildings.

Deductions may be made for outside aid available within 30 minutes, for which no adequate assignment of response is made, a credit equal to ⅓ the points which the full capacity of this aid decreases the deficiency in total capacity.

14. RESERVE PUMPERS.—The total pumper capacity, including reserve pumpers, with ⅛ of the regular pumpers, including the largest, out of service, shall be sufficient to maintain the total required pumper capacity, under Item 13. The ability of the water supply to deliver a portion of the fire flow at pressures permitting direct hydrant streams may offset the need of reserve pumper capacity.

To maintain pumper companies, at least one pumper shall be in reserve for every 8 pumpers or major fraction thereof required to be in service, but not less than one.

a. For Reserve Pumper Capacity:
Use 1/10 Deficiency Scale.

b. For Number of Reserve Pumpers:
Add 1/10 Deficiency Scale.

Deduct 10 per cent. of the total points of deficiency for a and b for each 10 pounds above 30 pounds at which 10 per cent. of the required fire flow, but not less than 500 gallons, is available at the weakest place in the district considered.

15. CONDITION OF APPARATUS.—Apparatus shall be of sufficient strength for the service and weight to be carried, shall be of

good design, suitable for the service and shall be kept in good condition; the absence of annual tests and tests after all repairs, in accordance with National Board of Fire Underwriters' suggestions for testing, may be considered a deficiency.

General Condition of Apparatus:
Use ½ Deficiency Scale.

16. FIREBOATS.—A fireboat shall be required where there is an occupied wharf frontage of one mile and additional boats such as to give a proportion of one to each three miles of wharf frontage. Total fireboat capacity, within reasonable response distance, to be equal to ½ the required fire flow for the district protected.

For privately owned fireboats or tugboats with fire pumps and turrets, if operating only in the harbor and if arrangements are made for their regular response to waterfront alarms and for their operation under the chief of the fire department, credit shall be allowed equal to ½ the points which such boats decrease the points of deficiency in municipally owned fireboats. If such boats are not regularly tested, this credit shall equal only ⅓ the points.

a. For number of boats:
Use ½ Deficiency Scale.
b. And add, for capacity:
¼ Deficiency Scale.
c. And add, for condition of boats:
¼ Deficiency Scale.

17. POWERFUL AND SPECIAL STREAM APPLIANCES.—For cities involving buildings of large area, or structures 3 stories or higher, or conditions involving serious exposure hazard, adequate facilities shall be provided for the use of powerful streams; these will include 3-inch hose, facilities for siamesing lines, the installation of turret or monitor nozzles on apparatus and the carrying of deluge sets, portable monitor or turret nozzles; for special fires, cellar pipes and distributing nozzles are needed, also foam or other equipment for oil fires; these shall be in such number and so distributed as to assure satisfactory service. A complete ladder pipe shall be provided for each aerial ladder truck, either attached or convenient for quick attaching. Water towers are required in high value districts having over 10 buildings 6 stories and higher, such that one shall be within 1½ miles of every building 6 stories

high; an aerial ladder truck of a type permitting the use of a ladder pipe at an elevation of 65 feet may be considered as ½ a water tower.

a. For each water tower deficient, if needed, 10 points.

b. For other appliances: Add 1/5 Deficiency Scale.

18. Small Stream Appliances. — Hand extinguishers of various types, large chemical or booster water tanks, ¾-inch to 1½-inch hose, ½-inch and smaller tips, and spray nozzles or other special nozzles designed for interior fire fighting contribute to the quickness of extinguishing small fires with a minimum of water damage. Equipment shall be carried on sufficient apparatus and be so distributed as to assure satisfactory service.

For deficiency in equipment:

Use ½ Deficiency Scale.

19. Reserve Hose Carrying Vehicles.—Vehicles arranged to carry hose shall be sufficient in number to permit one for each 8, or fraction thereof, of the required number to be out of service, without reducing the number in service below that required. In addition to the hose carrying vehicles credited under Item 8 as in service, there shall be one or more vehicles, loaded with 1,000 feet of hose, preferably 3-inch, in reserve; an excess of loaded apparatus in service over that required may be considered as complying in whole or in part with this.

For deficiency in number of reserve hose wagons, based on ⅛ the companies required:

Use 1/5 Deficiency Scale.

Add, for lack of loaded reserve hose wagon, 10 points if 3-inch hose is not supplied, and 20 points if no hose.

20. HOSE.—For hose companies and pumper companies at least 1,000 feet of 2½-inch hose shall be assigned to and respond with the apparatus.

In all cases there shall be a complete spare shift at the station or at conveniently located hose depots; hose on reserve hose wagon may be considered as spare hose where two or less companies are required.

For cities of less than 50,000 population, if more companies are provided than called for under Item 8, the total amount of hose carried by all apparatus, divided by the required number of companies shall be considered as the average amount carried per company.

a. For average amount of hose carried per company:
Use ½ Deficiency Scale.

b. Add for average spare hose per company:
¼ Deficiency Scale.

21. CONDITION OF HOSE.—Hose shall be in good condition and shall be tested annually to 200 pounds; suitable facilities shall be provided for washing, drying and storing hose. A service of 7 years should be expected before being in such condition as to require discarding; hose over 5 years old, if not regularly tested, may be considered as in poor condition. Hose couplings for 2½- and 3-inch hose and 2½-inch hydrant outlet threads shall be uniform.

a. For per cent. of total amount of hose in service in poor condition, and for absence of suitable tests:
Use ½ Deficiency Scale.

b. Add 5 points for each different thread more than one.

22. EMERGENCY EQUIPMENT.—Every pumper, hose and ladder company shall be provided with an approved type N gas mask for each two (2) men, with a minimum of 2 masks, and in cities where conditions exist where such masks may not prove sufficient under all conditions of fire service there shall be approved self-contained breathing apparatus, so distributed as to be available where required within a running distance of 3 miles; the operation of special rescue companies may not reduce the deficiency

in gas masks more than 50 per cent. Depending upon the character and type of protection necessary there shall also be provided special facilities, such as: flood-lighting; hydrant thawing devices; compressors; oxy-acetylene cutting equipment; power and wrecking equipment; these may be located on special apparatus, or carried on other apparatus.

For deficiency in equipment needed:
Use ¼ Deficiency Scale.

23. MINOR EQUIPMENT.—Complete minor equipment shall be provided for each company; this to include shut-off nozzles from ¾-inch to 1¼-inch and open smooth-bore nozzles from 1⅛-inch to 1½-inch, short ladders, door openers, nets, suction adapters, double connections, helmets, ladder straps, lanterns, hose jackets, and sufficient other equipment to enable the firemen to perform their work with greatest facility and dispatch.

Use 1/5 Deficiency Scale.

24. FUEL.—Good quality fuel shall be available in sufficient quantities at convenient points. Apparatus tanks, if filled at stations, shall be by hose and outside the station. Suitable provisions shall be made for delivery at fires.

Use 1/10 Deficiency Scale.

25. REPAIR FACILITIES.—Adequate, preferably departmental, facilities for making ordinary repairs in any municipality and major repairs in cities over 50,000 population must be provided. It is particularly desirable to have equipment standardized; wheels, hose and nozzle tip couplings, play-pipes, tips, and minor equipment. Spare parts, fittings, tools, wheels and tires should be on hand. Adequate means shall be provided for testing, maintaining and charging storage batteries.

Repair facilities and spare parts:
Use 1/5 Deficiency Scale.

26. SALVAGE APPLIANCES. — Salvage equipment, including covers, squeegees, mops, brooms, sawdust, tarpaper, sprinkler heads and tools, shall be sufficient in amount, so distributed, and with response so arranged that satisfactory salvage service can be performed in the area covered by the fire department. The equip-

ment may be either on separately manned apparatus or distributed on other fire apparatus, but in cities of over 100,000 population there shall be, in addition to that carried on pumpers and ladder truck, at least 20 covers on a piece of apparatus, in service or reserve, located in proximity of each high value section susceptible to heavy water damage.

For Amount, Distribution and Response of Salvage Appliances:

Use ¼ Deficiency Scale.

27. FIRE STATIONS.—Houses shall be adapted for the service; ease and quickness of response are important; commercial garages are not considered as satisfactory; suitable heating facilities shall be provided and where an attendant is not on duty, daily visits shall be made to the station.

Houses unadapted for the service:

Use 1/5 Deficiency Scale.

28. REGULATIONS AND DISCIPLINE.—Provision shall be made in complete printed regulations for control of the department and authority given the chief to enforce them, subject to review or confirmation by the supervising body or the civil service commission. Discipline shall be rigidly maintained and penalties impartially imposed and sustained.

Provision for and enforcement of discipline:

Use ⅓ Deficiency Scale.

29. DRILLS AND TRAINING.—Drills in charge of a competent officer shall be regularly held at a drill tower for all company members of the department. They shall be supplemented by frequent drills and instructions at fire stations. An officers' school or conference shall be regularly held. Drills shall be classed as not better than 30 per cent. deficient if only for newly enlisted men, or if no drill tower, or equivalent facility, is provided.

Use ½ Deficiency Scale.

30. RESPONSE TO ALARMS.—Response is assumed to be with automobile apparatus; where hand or horse drawn or towed, a deficiency will apply. An adequate running card shall be established, providing for first and subsequent alarms. Consideration shall be given to covering the city during second or greater alarms;

the excessive movement of companies is objectionable; credit shall be given to the manning of reserve apparatus at fire stations. Apparatus shall respond to all first alarms in amount commensurate with the normal hazard of the district, but not less than as follows:

In mercantile and manufacturing districts:

For cities under 5,000 population, one pumper or hose company and such ladder service as may be required.

For cities under 50,000 and over 5,000 population, not less than 2 pumper or hose companies and such ladder service as may be required.

For cities over 50,000 population, not less than 2 pumpers or hose companies for day time response and 3 for night response, with 1 ladder company both day and night

For cities of 100,000 population or over:

For first alarms during other than daylight hours the response shall be four pumper companies and two ladder companies.

Two of the pumper companies shall be provided with two pieces of apparatus, a pumper, which may carry hose, and a hose carrying vehicle with turret nozzle.

One of the pumper companies may be replaced by a hose company or a squad company or a rescue company. Where pressures are such that direct hose streams are used only one of the companies need be a pumper company.

For daylight hours the response may be reduced to two pumper companies and two ladders.

The above response shall be irrespective of the type of alarm, whether box, telephone, automatic or sprinkler water flow, except that where the telephone indicates definitely an automobile fire or fire other than in a building the response may be only one pumper or ladder company.

In residential districts: One pumper or hose company for cities under 5,000 population. For over this population, not less than 2 pumper or hose companies and adequate ladder equipment. In densely built sections and where buildings approach the dimensions of hotels, the response should be greater and in some cases equal that for mercantile or manufacturing sections.

For response to first alarms:

a. Use ¼ Deficiency Scale for high value districts.

b. Add ¼ Deficiency Scale for residential.

Note.—Deficiency to be based on the apparatus required and shall be figured separately for box alarms and telephone alarms, and the points of deficiency applied in ratio of the number of each kind to total first alarms. A deficiency shall apply under this item if there are not sufficient existing companies.

When the number of companies in service is in excess of the required first alarm response and the running card does not provide for response to second and subsequent alarms, nor for covering territory left vacant, add:

c. No provision for subsequent alarms, 10 points.

d. No provision for covering in, 10 points.

e. For percentage of apparatus hand drawn, or towed, or horse drawn and without horses in the station:

Use ½ Deficiency Scale.

31. FIRE METHODS.—These shall be modern and include the liberal use of small streams, shut-off nozzles and salvage appliances to reduce water damage, the use of appliances for powerful streams on serious fires, suitable ladder work and ventilation and the general policy of attaching lines to siamese connections serving sprinklers and standpipes. Lack of proper equipment and man power to be considered in determining deficiency in fire methods.

For ineffective fire methods:

Use Full Deficiency Scale.

32. CONDITIONS AFFECTING FIRE DEPARTMENT OPERATIONS.—All streets in closely-built sections of the city, approximately the district covered by the water distribution system, to be paved and in good condition. Macadam or similar pavements are satisfactory in residential districts.

a. For streets not paved or in poor condition:

Use ¼ Deficiency Scale.

Railroad grade crossings, drawbridges, automobile parking and other similar features shall be considered in respect to the probable delay in response; also cross-walks, gutters and steep grades which prevent rapid movement of apparatus. Traffic regulations,

particularly parking in narrow streets, and enforcement of ordinances giving fire department right of way shall also be considered.

b. Conditions causing delays in response to the high value district considered:

Use ½ Deficiency Scale.

The presence in the high value district of considerable overhead wires in streets, alleys and rear of buildings, and of trolley wires in streets within 10 feet of the curb, introduces a more or less serious obstruction to the use of ladders and tends to break up fire streams or to hinder the use of water towers, ladder pipes, etc.; where such wires, or some of them, carry high-potential current, the danger to firemen from coming in contact with charged wires is often severe, especially if no arrangement is made to quickly cut out any sections in the district considered. Extra high-potential wires (over 5,000 volts) in any occupied part of the city are considered a menace to fire fighting. Deficiency in these features is to be applied in proportion to seriousness of general conditions.

c. For seriousness of overhead wire obstructions in the district considered:

Use 1/5 Deficiency Scale.

d. For the amount and condition of overhead high-potential (over 600 volts) wiring in the district considered:

Use 1/10 Deficiency Scale.

e. For the amount and condition of overhead extra high-potential (over 5,000 volts) anywhere in the municipality:

Use 1/10 Deficiency Scale.

33. BUILDING INSPECTIONS.—Systematic and frequent inspections shall be made by company and department officers to acquaint them with local conditions and records of such inspections shall be kept both by notes and sketches.

Use 1/10 Deficiency Scale.

34. RECORDS.—Proper records of all fires, fire methods, losses, apparatus and all department matters shall be kept.

Use 1/10 Deficiency Scale.

FIRE ALARM SYSTEM

Note.—Items 1 to 20, inclusive, to apply to a municipally owned or controlled telegraph system for receiving and transmitting alarms of fire. Items 21 to 23 are to apply to the auxiliary service furnished by telephone. Where fire stations are not connected by fire alarm telegraph circuits, a total deficiency of 350 points shall be applied and additional points debited for deficiencies in such telephone system as is available, under Items 3 and 4 and Items 21 to 23, inclusive; credit to be given under Item 18, for street telephones accessible to the public, to the extent of ½ the credit for municipally owned fire alarm boxes, with deficiencies under Items 16, 17 and 19 applied.

Where reference is made to Standards for Municipal Fire Alarm Systems, the current edition issued by the National Board of Fire Underwriters shall be used.

1. QUALIFICATIONS OF MANAGEMENT.—Management to be experienced and qualified; a deficiency will apply where the superintendent or other officials also perform fire duty, or devote only part time and are not readily available. Poor maintenance, due to inadequate financial support or other causes, may be considered under this item.

Not qualified or system not properly maintained:
Use 1/10 Deficiency Scale.

2. MAINTENANCE FORCE.—Force to be adequate for maintenance or good provision made for obtaining emergency help, and to be competent. Application to be based largely on condition of the system.

Maintenance force inadequate or incompetent:
Use 1/10 Deficiency Scale.

3. OPERATORS.—Operating force shall consist of some competent person, controlled by the municipality, but not necessarily at fire alarm headquarters, on duty at all times to handle telephone alarms; provided that in municipalities of less than 10,000 population ½ credit, and in larger cities ¼ credit, may be given for a telephone operator on duty at each public exchange at all times, with facilities for transmitting or sounding coded signals giving

the location of the fire. In cities handling an average of over one alarm a day an operator shall be on duty at fire alarm headquarters to handle telephone alarms and to test and operate the fire alarm system; in such cities, if fire alarm boxes are not available in high value districts or manual operation is depended upon for transmission of alarms, two operators shall be on duty at all times. The fire alarm operator or operators may also act as department telephone operator or as an operator of a police signaling system.

Where practically all telephone alarms are transmitted to some fire station, and any member of the company is detailed to handle telephone alarms, a deficiency will apply for competency and if the member acting as operator is not left on duty when apparatus goes out, a further deficiency would apply, ranging up to 75 per cent. If night watch is not maintained at the point where telephone alarms are received, an additional deficiency might apply.

a. Operating force inadequate or incompetent:
Use 1/5 Deficiency Scale.

b. Telephone operator not in fire alarm headquarters (applied only to places receiving over one alarm a day):
Use 1/10 Deficiency Scale.

4. HEADQUARTERS.—Apparatus on which operation of the system and the receipt and transmission of alarms are dependent, to be housed securely against fire, including danger from conflagration and damage from other causes When service is dependent entirely upon the telephone exchange, application shall be made to the exchange building. Combustible material to be a minimum in mountings, etc.

Suitability of location of headquarters equipment:
Use 1/5 Deficiency Scale.

5. APPARATUS AT HEADQUARTERS.—To be such as to ensure receipt, recording and transmission of all alarms as specified in the Standards for Municipal Fire Alarm Systems, and to be in good condition.

In automatic systems, registering device and means of manual transmission of alarms need not be at fire alarm headquarters, but must be where telephone alarms are received. Telephone service not to be considered under this Item; see Items 21 and 23.

For incomplete or poor condition of apparatus at headquarters:

Use ½ Deficiency Scale.

6. Circuit and Instrument Protection.—To consist of fuses and arresters as required in the Standards for Municipal Fire Alarm Systems. To be applied both as to amount and kind.

Use 1/6 Deficiency Scale.

7. Current Supply.—Storage batteries or other current supply to the system shall be in accordance with the Standards for Municipal Fire Alarm systems, and shall be suitably located and protected against interruption.

Use 1/10 Deficiency Scale.

8. Circuits Underground. — All circuits shall be underground; box circuits serving fire stations count as alarm circuits and shall be applied under both *a* and *b* below.

a. Use 1/10 Deficiency Scale for box circuits.

b. Add 1/10 Deficiency Scale for alarm circuits.

9. Condition and Materials of Circuits.—Circuits shall test free from grounds and crosses, and shall show an excellent service record as to breaks and other faults. Material complying with the Standards for Municipal Fire Alarm Systems, with suitable tests on acceptance, are deemed most suitable. Workmanship of installation and maintenance shall be of high grade. Poles to be substantial. Box leads to be well protected.

Use 1/5 Deficiency Scale.

Where circuits serving the high value district considered have good construction and are entirely underground, use 1/10 Deficiency Scale for condition of overhead elsewhere.

10. Circuits Near High-Potential or Seriously Exposed to Damage.—Circuits shall not be in same duct or manhole nor on same pole with high-potential circuits. The running of circuits into buildings other than fire stations introduces a hazard.

Circuits on poles or in manholes with high-potential circuits:

Use 1/20 Deficiency Scale.

Add 1/20 Deficiency Scale for other conditions endangering circuits.

11. Open or Grounded Circuits.—All box and alarm circuits must be normally closed, all-metallic, and under constant test.

At headquarters and at fire stations, sufficient main line instruments or instruments on normally closed and supervised local circuits shall be provided to assure receipt and transmission of alarms; other instruments or devices may be on normally open or non-supervised local circuits.

The running of both sides of circuits in the same cable increases the probability of interruption of service.

Normally Open or Ground Return Circuits:

a. Effect on receipt and transmission at fire alarm headquarters.

Use 1/10 Deficiency Scale.

b. Use in connection with essential fire station equipment.

Use 1/10 Deficiency Scale.

Common Cable:

c. Main cables contain both sides of circuits.

Use 1/10 Deficiency Scale.

12. Number of Circuits.—Not more than the area which should be protected by not more than 20 boxes should be dependent upon any box circuit; except that when a circuit is entirely in cable, either aerial on messenger or underground, or the boxes operate in emergency on the ground return principal, the area protected by 30 boxes may be permitted. Only boxes, and in an automatic system registers and sounding devices in fire stations and waterworks pumping stations, may be connected to box circuits. No alarm circuits shall connect instruments in more than 5 fire stations.

a. Use 1/10 Deficiency Scale for box circuits.

b. Add 1/20 Deficiency Scale for alarm circuits.

Note.—Apply on basis of per cent of existing circuits rendering protection to an excessive area. Do not apply in single circuit systems, where deficiency has been applied under Item 5, for lack of a repeater. In automatic system, if no alarm circuits are provided, do not apply under b unless more than 5 stations are on any one box circuit.

13. Circuits to and Apparatus in Fire Stations.—Except where only a single circuit system is required, each fire station

must receive alarms over two alarm circuits; in an automatic system some box circuit shall extend to each fire station, and each box circuit shall extend to some fire station; such circuits may count as one of the required alarm circuits. Fire station apparatus shall include a recording and sounding device on the primary alarm or box circuit, and a sounding device on the secondary alarm circuit. Telephone apparatus not to be considered under this item.

a. For deficient circuits to fire stations:
Use 1/10 Deficiency Scale.

b. And add for deficient apparatus:
1/10 Deficiency Scale.

c. And add, in systems where automatic transmission is used, for number of box circuits without an alarm instrument in some fire station:

1/10 Deficiency Scale.

14. Inside Wiring.—Wiring of fire alarm circuits in buildings shall be in accordance with the Standards for Municipal Fire Alarm Systems. They shall be adequately protected against injury by fire or by mechanical means.

a. Use 1/10 Deficiency Scale for Headquarters.

b. Add 1/20 Deficiency Scale for circuit wiring in fire stations.

15. Boxes. — Boxes, including private boxes, shall be non-interfering and succession, except: In a non-repeating system, with one box on the circuit, or in a manual system with not more than 10 boxes on such circuit in a limited area, interfering boxes may be permitted; in a single circuit system not exceeding the permitted number of boxes they need not be succession.

a. Use 1/10 Deficiency Scale for interfering boxes or boxes of poor design.

b. Add 1/20 Deficiency Scale for non-succession boxes.

16. Conspicuousness and Accessibility of Boxes.—Public boxes and private boxes accessible to the public shall be conspicuous as applying to location and designation, and there shall be designating lights at night on or close to all boxes in high value districts; the operating device shall be visible and suitably protected.

For conspicuousness:

a. Use 1/20 Deficiency Scale for high value district considered.

b. Add 1/20 Deficiency Scale for other districts.

c. Add 5 points for each 10 per cent. not adapted to prompt turning in of alarms.

17. Condition and Tests of Boxes.—Boxes shall be maintained in good operative condition. They shall be tested monthly and after electrical storms; tests to include visual inspection, operation, cleaning and repairing, and the testing of grounds for emergency grounding boxes.

For frequency and adequacy of tests:
Use 1/10 Deficiency Scale.

18. Box Distribution.—Proper distribution of boxes requires a public box, or a private box accessible to the public, visible from, and within 500 feet of, every building in mercantile and manufacturing districts, and 800 feet of every important group of buildings elsewhere.

For numerical deficiency of boxes:

a. Use ½ Deficiency Scale for high value district considered.

b. Add 1/5 Deficiency Scale for other districts.

19. Tests and Records (Except box-tests). — Circuits at Headquarters to be tested 3 times daily in manual systems, twice daily in automatic repeating systems and at least once daily in automatic non-repeating systems; also frequently in wind and electrical storms; tests to be for current strength, voltage, grounds and continuity. Battery cells to be tested for voltage and electrolyte, weekly, and for capacity at least yearly. Circuits to be examined monthly and after wind or sleet storms. Complete records to be kept of tests, of apparatus and layout of systems, and of all troubles. Condition of system to be used in judging of thoroughness of tests.

a. For frequency and adequacy of tests:
Use 1/20 Deficiency Scale.

b. For Records, add 1/20 Deficiency Scale.

20. Speed of Alarms.—Speed of boxes and of alarm transmission shall not be less than 1 stroke per second in automatic and 2 strokes per second in manual systems. Outside sounding devices, if necessary, to be operated on separate circuits, so as not to delay the operation of the system.

Speed of Alarms:
Use 1/10 Deficiency Scale.

TELEPHONE SERVICE

21. There shall be connected a telephone at each fire station by a single party line, preferably from some central point where a municipally controlled operator is on duty at all times; for cities having more than 5 fire stations, these shall extend from a private switchboard. Provisions shall be made permitting stations to be communicated with simultaneously or in groups.

For Fire Department Telephone System:
Use 1/5 Deficiency Scale.

22. Telephone alarms shall be transmitted from the public exchange to the same place in all cases and not to any fire company called nor to all fire stations simultaneously; they shall be transmitted, by the fire alarm operator, to all fire stations as recorded signals after notifying the nearest company by telephone. The sounding of ward or box numbers on outside sounding devices may be sufficient in towns having call or volunteer fire departments.

For Transmission of Telephone Alarms:
Use 1/10 Deficiency Scale.

23. Sufficient circuits from the telephone exchange shall be reserved, and specially listed, for fire calls to assure receipt of alarms, and exchange operators shall be instructed in transmitting emergency calls.

For provisions reserving lines for transmitting telephone fire alarms from the telephone exchange:
Use 1/5 Deficiency Scale.

POLICE

From the standpoint of fire protection, the duties of the police are the discovery of fires and the sending of alarms, the preserving of order at fires, and the reporting of buildings under construction without permit. Adequate service requires proper communicating systems, to include street boxes and call system, telephone service, teletype and radio, singly or combined, such as to meet the needs of the community. Also means of quickly concentrating police at fires.

Municipalities of less than 2,000 population should have a watchman on duty at night in the mercantile district; for over this population there should be an adequate number of patrolmen on duty day and night, and if over 15,000 population, sufficient vehicles and ropes and a signaling system shall be provided.

1. **Co-operation with fire department:**
   Use 1/10 Deficiency Scale.
2. **Deficient signaling and emergency service.**
   Use 1/10 Deficiency Scale.
3. **Cooperation with building department:**
   Use 1/10 Deficiency Scale.

Note.—Where no police force or watchman is maintained, but is required, grade Items 1 and 3 as 75 per cent deficient; if a Fire Police force is maintained, do not consider Item 2, and use 1/20 deficiency under Item 1.

BUILDING LAWS

Adequate building laws, either State or Municipal, shall be enacted. There shall be prescribed fire limits, including all closely built mercantile and adjoining manufacturing districts and surrounding blocks on all sides which constitute an exposure to the district or within which new construction of a mercantile or manufacturing character is developing; within these limits, frame construction shall be suitably restricted. Proper regulations shall be enacted for the items listed below. Comparison with the provisions of the Building Code recommended by the National Board of Fire Underwriters is to be the basis for judging these regulations. Roof-coverings required throughout the municipal limits shall be Underwriters' Laboratories Class C or better. A properly qualified official shall be in charge, with a requisite number of assistants. Plans of important buildings and proper records of building permits and operations and inspections shall be kept.

Note.—Grade Items 1, 2 and 3 for deficiency in laws; add for deficiency in enforcement; the total under any subitem for both lack of requirement and lack of enforcement not to exceed the points given.

		Points
1.	Fire limits: For each 10 per cent. of area inadequate	5
2.	Laws in regard to the following subjects inadequate or not enforced:	
	a. Heights.	10
	b. Areas.	10
	c. Protection to exposed windows.	10
	d. " " vertical openings.	10
	e. " " communications through fire walls.	8
	f. Frame construction in fire limits.	10
	g. Wall thicknesses.	10
	h. Chimneys and heating apparatus, including air conditioning.	10
	i. Fireproof construction.	5
	j. Private fire protection, including sprinklers.	5
	k. Provisions for fire stops.	5
	l. " " exits.	2
	m. " " parapets.	3
	n. " " quality of materials and workmanship.	2
	Total Points	100

3. Fire-resistive roof coverings not required: For each 10 per cent. of area of the city. 4

Omit farm lands or other territory not subject to building operations; use as basis approximately the area covered by water distribution system.

Where wooden shingles are prohibited except in areas having buildings 12 feet apart, apply ½ the points of deficiency due to this area.

4. Records:

a. Poor. 5

b. None. 10

FIRE PREVENTION

The passage of laws, either State or Municipal, on the subjects of electricity and explosives and flammables, and proper enforcement of such laws, produce some immediate results. The National Electrical Code is the generally recognized standard for electric wiring. Its adoption by ordinance is of first importance; the laws should also provide that current shall not be furnished until installations have been inspected and approved, and should provide for reinspections and the correction of defects which have developed. Enforcement may be through a properly qualified official or under insurance inspection backed by a proper city ordinance.

Where electricity is not used the hazards of glass body oil lamps, swinging and open gas flames, natural gas at high pressure or of gasoline and acetylene lighting systems are usually present. Hazards of these materials may also be present in installations for heating or cooking. Proper laws should regulate these and, in addition, the manufacture, storage, transportation and use of all other explosive or flammable substances or processes and the care of combustible rubbish of all kinds. Requirements should conform to the Suggested Fire Prevention Ordinance and the standards promulgated by the National Board of Fire Underwriters. Enforcement to be through a Bureau of Fire Prevention, the duties of which in smaller municipalities may be assigned to some qualified official of the municipality. Frequent inspections shall be made; the most approved method of inspection is by members of the fire department, supplemented by the official in charge or members of his organization having knowledge of special hazards.

1. Electric Lighting and Heating.

a. For deficiency in laws, including reinspection, and for lack of enforcement:

Use 1/10 Deficiency Scale.

Note.—If the National Electrical Code is not enacted but is enforced by ruling of the inspector, grade not better than 50 per cent. deficient. Consider under enforcement the lack of a suitable agreement between the municipality and the local electric light company as to connecting services before approval.

2. ENFORCEMENT AGENCY FOR FIRE PREVENTION.

For lack of requirement for inspection and for inadequacy of enforcement agency, either in numbers or in competency.

Use 1/10 Deficiency Scale.

3. OIL LIGHTING AND HEATING (Including Fuel Oil installations and Stoves, Heaters and Lamps using Gasoline, Kerosene, Alcohol and other flammable Liquids).

For deficiency in laws and enforcement.

Use 1/5 Deficiency Scale.

4. GAS LIGHTING AND HEATING (Including Acetylene and Compressed or Liquified Gases).

For deficiency in laws and enforcement.

Use 1/10 Deficiency Scale.

5. STORAGE, TRANSPORTATION AND USE OF FLAMMABLE LIQUIDS.

For deficiency in laws and enforcement.

Use ⅓ Deficiency Scale.

6. HANDLING, STORAGE AND USE, INCLUDING SPECIAL PROTECTIVE EQUIPMENT NEEDED, OF HAZARDOUS CHEMICALS AND MATERIALS, REFRIGERANTS, DUSTY MATERIAL, EXPLOSIVES, PYROTECHNICS, NITROCELLULOSE MATERIALS AND FILMS, MATCHES, COMBUSTIBLE FIBRES, FLAMMABLE FINISHES, HAZARDS OF GARAGES AND REPAIR SHOPS, DRY CLEANING.

For deficiency in laws and enforcement.

Use ½ Deficiency Scale.

Approximate Weights for Items Covered in 6.

	per cent.
Hazardous Chemicals and Materials.	20
Explosives.	5
Pyrotechnics.	6
Nitrocellulose and Films.	10
Matches.	2
Combustible Fibres.	10
Garages and Repair Shops	15
Dry Cleaning.	12
Refrigerants.	5
Dust.	5
Flammable Finish.	10
	100

7. Control of Rubbish, Trash, Ashes, Bon-Fires, Packing Material and Junk Storage.

For deficiency in laws and enforcement.

Use 1/5 Deficiency Scale.

Approximate Weights for Items 7.

	per cent.
Rubbish and Trash.	40
Ashes.	15
Bonfires.	15
Packing Material.	20
Junk Storage.	10
	100

8. Electrical and Fire Prevention Records.

For deficiency in fire prevention records.

Use 1/20 Deficiency Scale;

And add up to 3 points for lack of satisfactory electrical records.

STRUCTURAL CONDITIONS

This schedule is designed to be applied to any mercantile or manufacturing district; in the smaller cities it is to be applied to the principal mercantile district, but in larger cities a separate grading may be desirable for each distinctive high value district. For communities with two or more districts of about equal importance the application will be made for the district of greatest potential hazard. When a district is divided by a break or barrier, Items 1 and 14 will be applied for the largest subdivision, and all other items on the entire district.

In bounding a district, streets and alleys, sometimes extended, railroads and natural features will be used where practicable and every block or part block shall be included in which approximately ⅓ of the area is of the same general class as the district.

Where district bounds are taken as "blank" feet back of a street front and there is considerable open space back of the buildings, include as in the district approximately 50 feet back of the buildings, but not to exceed ½ the distance to the nearest buildings.

Wharf district boundaries to extend from end of pier to end of pier, where piers are continuous along the water front, and slip area to be counted as open area.

Narrow streets, inaccessibility of buildings, congestion of the district and of the individual blocks, poor general structural conditions and exposures from surrounding sections all increase the probability of sweeping fires.

Buildings of fireproof construction, sprinklered brick buildings, fire breaks, fire barriers and, where there is also a domestic system furnishing hydrant supply, separate high pressure fire system designed to deliver capacity at 90 pounds hydrant pressure or more, form important mitigating features.

Under Items 6, 8, 9 and 10, in determining the number of buildings, exclude sheds and additions and buildings of less than 300 square feet area, except that two or more such buildings may be counted as one building if adjoining and totaling over 300 square feet area.

Consider lumber or wood storage as frame construction and assume passageways as breaking up the area.

1. AREA OF DISTRICT (or largest subdivision).—An undivided area increases somewhat the possible extent of a sweeping fire. Fire breaks and barriers subdividing a district will include: Rivers, parks, streets, railroad tracks, unoccupied territory, railroad embankments and similar structures, and groupings of mutually supporting fireproof or sprinklered structures which effectively subdivide a district. Fire breaks to be recognized as effectively subdividing a district shall have a total width of at least 150 feet.

Area of District or of Large Subdivision:

400	acres or more.	50	Points.
300	"	30	"
200	"	20	"
100	"	10	"
50	"	4	"
10	"	0	"

2. STREET WIDTHS IN DISTRICT.—A through passageway, more than 20 feet in width, shall be considered as a street. Total length of streets not to include bounding streets.

Where buildings are uniformly set back of the street line, the width of street may be assumed as distance from building front to building front.

a. For each 10 per cent. of total length 50 feet wide or less. 5 Points.

b. Add for each 10 per cent. of total length under 80 feet wide. 5 Points.

Where the district is less than 100 acres, apply b in direct ratio of the area of the district to 100 acres.

3. ACCESSIBILITY OF BLOCKS.—A block shall be considered inaccessible if more than 50 per cent. of the number of buildings have only one side accessible from a street, alley, driveway or courtyard and other open spaces readily accessible from the street. All streets, as defined under Item 2, shall be considered as forming block boundaries.

For per cent. of blocks inaccessible:

Use 1/10 Deficiency Scale.

4. Per Cent. of Area of District in Streets and Open Spaces Which Cannot be Built Upon, Including One-half Width of Bounding Streets:

50 per cent. or over	0 Points.
40 per cent.	20 "
30 per cent.	50 "
20 per cent.	90 "
10 per cent.	130 "

5. Per Cent. of Block Area (Including Alleys) Built Upon. Open parking spaces are not to be considered as built upon.

0 per cent.	—140 Points.
10 per cent.	—100 "
20 per cent.	— 70 "
30 per cent.	— 40 "
40 per cent.	— 20 "
50 per cent.	0 "
60 per cent.	10 "
70 per cent.	20 "
80 per cent.	35 "
90 per cent.	50 "
100 per cent.	70 "

Where less than 50 per cent. of the block is built upon, the lack of congestion is considered as below normal and credit or minus points of deficiency are allowed.

6. Heights of Buildings.—Buildings on side hill, use as height of the building the maximum height on a street front, but not alley front.

Note.—Sub-items a and d below do not apply where the Water Department and Fire Department combined total less than 2,200 points.

a. Frame buildings 2 and 3 stories high.

For per cent. of total number of buildings:

Use ½ Deficiency Scale, but deduct from the points of deficiency 10 per cent. for each 100 points that the Water Supply and Fire Department combined are less than 3,200 points.

b. Frame buildings 4 stories and over:

For per cent. of total number of buildings, use 2 times Deficiency Scale.

c. Frame buildings 6 stories and over:

For per cent. of total number of buildings, add 4 times Deficiency Scale.

d. Non-fireproof buildings (except frame) 2 to 4 stories high.

For per cent. of total number of buildings:

Add ¼ Deficiency Scale, but deduct from the points of deficiency 10 per cent. for each 100 points that the Water Supply and Fire Department combined are less than 3,200 points.

e. Non-fireproof buildings (except frame) 5 stories and over:

For per cent. of total number of buildings, add full Deficiency Scale.

f. Non-fireproof buildings (except frame) and semi-fireproof 7 stories and over:

For per cent. of total number of buildings, add full Deficiency Scale.

7. LARGE AND EXCESSIVE AREAS (other than frame), but including communicating areas without standard (double fire doors) protection:

If communicating brick and frame buildings combined exceed 5,000 square feet, apply the brick area and the frame area separately, but under the sub-item corresponding to the total combined area. Apply similarly for other combined areas of different classes of construction, making a charge under the sub-items corresponding to the total combined area.

When sprinklers protect the principal hazard, and basement if any, but not all stories, credit a proportional total floor area as sprinklered. Credit basement sprinklers only when additional floor areas are protected.

a. Unsprinklered non-fireproof areas exceeding 5,000 square feet and unsprinklered fireproof or semi-fireproof areas or sprinklered non-fireproof areas exceeding 10,000 square feet:

For per cent. of total built-on area, use ½ Deficiency Scale.

b. Unsprinklered non-fireproof areas exceeding 10,000 square feet and unsprinklered fireproof or semi-fireproof areas or sprinklered non-fireproof areas exceeding 20,000 square feet.

For per cent. of total built-on area, add full Deficiency Scale.

c. Unsprinklered non-fireproof areas exceeding 20,000 square feet and unsprinklered fireproof or semi-fireproof areas or sprinklered non-fireproof areas exceeding 40,000 square feet:

For per cent. of total built-on area, add full Deficiency Scale.

8. PARTY WALLS, FIRE WALLS, AND EXTERIOR WALLS WITHOUT OPENINGS.—When of standard thickness, as given in the National Board Building Code, with proper parapets and cut-offs at cornices, party walls, fire walls, and exterior walls without openings at frequent intervals in otherwise continuous block fronts lessen the danger of the spread of fire from building to building, provided such walls are in good condition.

a. Frequency of party walls, fire walls and exterior walls without openings:

Large number.	0 Points
Considerable number.	10 "
Moderate number.	25 "
Small number.	50 "
None.	80 "

b. Thickness of such walls:

Few thin. 5 Points.

At least one-third 4 inches deficient in some part. 10 Points.

At least one-third 8 inches deficient in some part. 20 Points.

Note.—Do not apply for deficiency in thickness where application was made for a Small number under a.

c. Condition of all walls, including parapets and exterior walls:

Fair.	10 Points.
Poor.	20 "

9. FLOOR OPENINGS.—Standard protection shall be provided on all communications between stories. Consider as protected all

1-story brick buildings, and all 2-story brick buildings where stairs are cut off from first floor by partitions approximately equal to the floor in fire resistance.

Buildings, other than frame, with unprotected openings: For each 10 per cent. of total number of buildings, 5 Points.

10. EXPOSED OPENINGS.—Openings in exterior walls, if exposed within 50 feet, shall be protected in a standard manner:

Buildings, other than frame, with openings exposed and not protected:

For each 10 per cent. of total number of buildings, 8 Points.

11. FRAME AREAS.—A frame area shall be construed as including continuous frame buildings which do not have a separation equal to 2 feet of clear space or a brick-filled wall with no openings in the wall.

a. **Frame areas of all sizes, including sheds and porches:**
   For per cent. of total built-on area, use full Deficiency Scale.

b. **Unsprinklered frame areas exceeding 5,000 square feet and sprinklered frame areas exceeding 10,000 square feet:**
   For per cent. of total built-on area, add full Deficiency Scale.

c. **Unsprinklered frame areas exceeding 10,000 square feet and sprinklered frame areas exceeding 20,000 square feet:**
   For per cent. of total built-on area, add full Deficiency Scale.

d. **Unsprinklered frame areas exceeding 20,000 square feet and sprinklered frame areas exceeding 40,000 square feet:**
   For per cent. of total built-on area, add twice Deficiency Scale.

12. PERMANENT AWNINGS AND COMBUSTIBLE ROOFS:

a. **For per cent. of street frontage covered with permanent awnings:**
   Use 1/10 Deficiency Scale.

b. **For per cent. of buildings with non-fire-resistive roof coverings:**
   Use ½ Deficiency Scale.

13. Conflagration Breeding Blocks.—When blocks in a district have a hazard distinctly greater than normal for the district, and are grouped, that is, the separating space is less than 100 feet, a deficiency shall be applied.

For each block in groups of two or more adjoining blocks. 5 Points.

14. Exposures to District.—In considering exposures, the prevailing direction of winds and the prevalence of frame construction and wooden shingle roofs in the exposing sections and the linear extent of the exposure must be taken into account. Consider each of the four sides of the district separately. When the district under consideration is subdivided by fire breaks or barriers, apply exposures of the largest subdivision.

a. Mild exposure.	5	Points
b. Moderate exposure.	10	"
c. Severe exposure.	15	"
d. Very severe exposure.	20	"

Add points of exposure of the four sides.

CREDITS

21. SUPERIOR CONSTRUCTION AND PROTECTION.—Buildings to be considered in this item as of fireproof construction must comply with the Building Code recommended by the National Board of Fire Underwriters in the essentials, except for protection to vertical and horizontal openings. Do not include semi-fireproof construction. Buildings with sprinkler protection will not be included unless all floors are protected.

a. For each 2 per cent., but not exceeding 40 per cent., of built on area covered with fireproof. 5 Points.

b. For each 1 per cent, in excess of 40 per cent, of built on area covered with fire proof. 1 Point.

c. For each 2 per cent., but not exceeding 40 per cent., of built on area covered with sprinklered construction (other than frame). 5 Points.

d. For each 1 per cent., in excess of 40 per cent., of built on area covered with sprinklered construction (other than frame). 1 Point.

Note: Fireproof buildings, if sprinklered, are credited under c and d in addition to the credit allowed under items a and b.

22. Where full fire flow is available as direct hydrant streams, either from the domestic system or from a high-pressure system, the maintaining of pumpers in service, with adequate provision for their response and operation, is considered an advantage as reducing the probability of a fire gaining headway in the interval of time necessary to control the flow from a broken main, and credit shall be allowed accordingly.

For each 10 per cent. of required pumper capacity available, based on ⅔ fire flow required, reduce points of deficiency 1 per cent. (after deducting Item 21).

23. HIGH PRESSURE FIRE SYSTEM.—A high pressure fire system may have gravity supply, direct pumpage supply or a combination of the two. It may be a separate system for fire service only, or may be the extension of a High service domestic supply into a Low service area, in which latter case only 2/3 the actual fire flow obtained shall be assumed as available capacity. Fire boat pipe lines shall also be considered, the probability of the boats

not being available being graded under Item 7. For emergency service of fire boats to systems having other source of supply, credit shall be given only under reliability (Items 7 to 17, inclusive) and for only ½ the points which this supply decreases the deficiency of the system.

To be standard, a high pressure fire system must comply fully with the various items listed hereinbefore under Water Supply and be capable of delivering in the weakest part of the system the full fire flow required by the table on page 14, including that necessary for a second fire; such supply to be available in an area equal to that served by the number of hydrants necessary to deliver this required fire flow when discharging 1,000 gallons a minute each. For standard fire service this quantity shall be available at a residual pressure of 250 pounds; residual pressures less than this, down to 90 pounds as a minimum, permit classing a system as a High Pressure Fire System, but of less worth in reducing the deficiencies in Structural Conditions. Hydrants to be of ample dimensions, with 4 independently gated hose outlets and with 8-inch gated connections to the mains; to be so distributed that the entire area of this district is protected and the average area served per hydrant shall not exceed 40,000 square feet.

For each 10 per cent. of combined adequacy and reliability of the High Pressure Fire System, deduct a percentage of the total points under Structural Conditions (after deducting Item 21) on the following basis:

For fire flow available at 250 pounds, 7.5 per cent.; for fire flow available at 200 pounds, 6.5 per cent.; for each 10 pounds under 200 pounds pressure, down to 90 pounds, at which fire flow is available, use a percentage 0.5 less.

Where the piping system is dry during a part of the year, only ½ the above percentage of credit will be allowed.

Note.—The value of a High Pressure Fire System to be determined on the basis of fire flow; when the system furnishes supply for other than fire purposes, fire flow shall be considered as the amount available after allowing for such other uses. The system shall be graded on the basis of a possible total deficiency of 1,000 points, application being made as under Water Supply, except as modified below:

Item 5.—Use 1/5 Deficiency Scale for means of notification of repair gang, competent officials and any pumping station.

Item 6.—a and b to be based on maximum quantity available in the district at the weakest point in the system, whether due to poor gridironing or elevation.

a. For fire flow at time of average domestic consumption:

Use 2 times Deficiency Scale.

b. For fire flow at time of maximum domestic consumption:

Use ½ Deficiency Scale.

c. Not to be applied.

Note.—Where there is a deficiency under Item 6, full requirements shall be the basis for Items 8, 9, 10, 11 and 16 instead of the quantity available as indicated on page 2.

Item 16.—To be for maximum effect on fire flow at the same pressure used under Item 6 a and b.

Items 20, 21, 22, 23, 26 b, 29 and 31 b.—Not to be applied.

Under each item the application must include any additional points due to deficiency of the plant furnishing power.

Per cent. of combined adequacy and reliability

$$= \frac{1{,}000\text{—points of deficiency}}{1{,}000}.$$

ADDITIONAL DEFICIENCIES

ADVERSE CLIMATIC CONDITIONS.—Applications of Items 1, 2, 3, and 4 are to be interpolated from charts prepared by the National Board of Fire Underwriters from available data of the U. S. Weather Bureau. These charts express in points of deficiency the relative influence on fires and fire losses introduced by climatic conditions and provide a measure of comparison between cities.

1. FREQUENCY OF HIGH WINDS.

2. SNOWFALL in excess of 10 inches per month.

3. SEVERE COLD WEATHER.

4. HOT DRY WEATHER.

5. UNUSUAL OR EXCEPTIONAL CONDITIONS.—Apply for conditions not measurable by the climatic conditions above, which offset protection and increase the probability of starting fires: These to include frequency and extent of forest fires which might extend into the city; tornadoes, hurricanes and cyclones which result in numerous fires or interruption of fire service; blizzards and severe snow storms which impede operation of the fire department; earthquakes of such intensities as to injure buildings, water mains and cause numerous fires; mine cave-ins affecting extensive areas, and floods which cover part of the district considered or cause wide detours of fire apparatus.

On the basis of numbers; one each 10 years shall be classed as a frequency deserving a 75 per cent deficiency, and one each 20 years as deserving a 25 per cent deficiency; the extent or effect of the conditions may increase or decrease the deficiency based on numbers.

Use 1½ times Deficiency Scale.

DIFFERENCE IN GRADING OF WATER SUPPLY AND FIRE DEPARTMENT.—Where the fractional classes corresponding to the points of deficiency of the water supply and fire department, that is, the points of deficiency divided respectively by 170 and 150, differ by more than 2 classes, there shall be added to the total points of deficiency a certain number of points varying with the

amount of divergence between the classes of the two features. The number of points to be added shall be determined by the following tables, proportioning for fractional divergence in classes:

Divergence in Classes.	Additional Points of Deficiency.
2	0
3	45
4	90
5	150
6	225
7	315
8	420
9	540
10	680

NEWS OF THE FIELD

"Geared to the Times" can well be said of the American Water Works Association's Sixty-Second Annual Meeting.

The program of the "A.W.W.A. Conference on Wartime Water Works Problems made it p ain that problems peculiar to the war would be foremost in the discussion—but not until the meetings got under way was the loyalty of A.W.W.A. members able to show itself in the mass determination to sacrifice everything but the essentials of service so that material we commonly use could flow into the war effort.

The surprise event of the Conference was the appearance of J. A. Krug, Chief of the War Production Board's Power Branch. Thursday morning's two scheduled sessions were drawn together to hear him. He spoke earnestly, simply and directly. He made it plain that water works men have not yet understood how serious the war material problem is and how things we have always used must become scarce. Those who heard him will probably never forget the experience—a technical audience was welded together into a loyalty more than lip service. That morning alone justified the entire gathering.

More than a hundred speakers took part in the technical sessions. The session rooms were crowded. The men stayed late—the meetings opened more promptly than is the custom.

Fourteen hundred and thirty-eight persons officially registered. This compares with 1445 at Toronto in 1941 and 1467 at Kansas City in 1940.

In the analysis of methods of travel by which the registrants came to the Conference, the effect of gas and tire rationing is apparent. Of the 1393 reporting methods of travel last year, 817 (including those from Toronto and environs) came by automobile; this year, of 1422 reporting, only 227 (excluding 264 local registrants) came by automobile. Train travel increased from 522 last year to 894 this year. Plane travel decreased from 49 last year to 28 this year. Nine arrived by bus. The remaining 264 who reported were either Chicagoans or lived near enough to use city transportation facilities.

The geographic breakdown of attendance shows that, aside from Illinois itself, represented by 377 members and guests, New York state sent the largest delegation—150. Pennsylvania and Wisconsin sent 99 and 93 respectively.

(Continued on page 2)

(*Continued from page 1*)

The Nicholas S. Hill Jr. Cup, awarded each year to the section with the greatest percentage gain in membership, this year went to the Illinois Section whose net growth of 78 members gave it a point score of 42.042, far ahead of its nearest competitor. The Virginia Section in second place gained 16 members for a score of 30.784; and Wisconsin, third, gained 17 members for a score of 21.488. This year for the first time, scores were computed on the new quota system based on urban population and the membership of each section. This system was devised to equalize the opportunity of all sections to compete for the cup, giving the larger ones credit for their present high membership totals.

The Henshaw Cup, which goes each year to that section having the greatest percentage of its members in attendance at its section meeting, went to the Minnesota Section (82.56 per cent). Second was the Montana Section (76.19 per cent), and third was North Carolina (63.72 per cent). Honorable Mention should go to the California Section which had 348 of its 552 members present for a percentage of 63.04.

S. F. Newkirk Jr., Engineer and Superintendent, Board of Water Commissioners, Elizabeth, N.J., was awarded the Diven Medal, which goes annually to that A.W.W.A. member judged to have made the greatest contribution during the year to the advance of the water works field. Mr. Newkirk received the Medal for his leadership of A.W.W.A. Committee 7M—Meters. The Committee's "Tentative Specifications for Cold Water Meters—Displacement Type—7M.1-T" was published in the December 1941 JOURNAL.

R. F. Goudey, Sanitary Engineer, Los Angeles Dept. of Water and Power, was the recipient of the Goodell Prize, given each year for the best paper published in the JOURNAL. His paper was "Practical Aspects of Cross-Connection, Inter-Connection and Back-Flow Protection" published in the March 1941 JOURNAL.

Made Honorary Members of the Association were: James M. Caird, Consulting Chemist and Bacteriologist, Troy, N.Y.; Wilfred W. DeBerard, City Engineer, Chicago; and William E. Vest, Superintendent of Water Works, Charlotte, N.C.

Recipients of Fuller Memorial Awards, listed by Sections, are as follows: California, Charles Gilman Hyde; Canadian, Robert William Angus; Florida, William Benjamin Gibson; Four States, Carl John Lauter; Illinois, Herbert Edson Hudson Jr.; Indiana, Blucher Adams Poole; Kentucky-Tennessee, Robert Paul Farrell; Michigan, Douglas Feben and Roberts Hulbert; Minnesota, Ronald M. Finch; Missouri Valley, William Theodore Bailey; Montana, Herbert Branch Foote; New Jersey, Joseph Arthur Carr; New York, Rollo Kimball Blanchard; North Carolina, William Christian Olsen; Ohio, Hayes Robinson Kuhns; Ohio (1940), Thomas Ridgway Lathrop, (Made at 1940 meeting of Ohio Section, held

(*Continued on page 4*)



Length of 36-inch cast iron pipe recently taken up and re-used elsewhere in Fort Worth, Texas. Note date mark on pipe

Salvaged and re-used because it's CAST IRON

THE salvage or re-use value of cast iron mains which must be abandoned or relocated has always been an economy feature of cast iron pipe. Today it is of prime importance. Cast iron pipe will serve out its full century of useful life, either in its original location (which may be temporary) or relaid elsewhere, even in another city. Many instances are on record of old cast iron mains taken up and re-used, or sold to other cities for re-use, or sold as scrap.

For example, the City of Fort Worth, Texas, was recently required by the State Highway Department to relocate a 36-inch cast iron main which has been in service about 40 years. The pipe was taken up, found in fine condition, moved to a new location and re-used.

It is impossible to foretell future requirements or population shifts in metropolitan cities but any public official can be sure that, when water or sewer mains must be abandoned or re-routed, the pipe can be salvaged or re-used, if it is cast iron pipe.

Pipe bearing this mark is cast iron pipe.

Available in diameters from 1¼ to 84 inches.

TRADE MARK REG.

CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER
1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

CAST IRON PIPE
PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

subsequent to 1940 annual convention of the Association. Listing omitted from 1941 Citation List.); Pacific Northwest, Milton Hunt McGuire; Rocky Mountain, Oliver Jesse Ripple; Southeastern, William Davis Moore; Southwest, Edward Ray Stapley; Virginia, Dayton Rice Taylor; Western Pennsylvania, James Smith Dunwoody (deceased); West Virginia, Thomas Lee Young; and Wisconsin, Walter Anderson Peirce. The Cuban and New England Sections made no selections during the past year.

Total membership in the Association as of noon June 24 reached a new high at 4,386, a gain of 350 members since the corresponding time at the Toronto Convention, exactly one year previously.

The 1943 Conference will be held in Cleveland, probably opening on June 14. Headquarters are not yet selected.

New President of the A.W.W.A. is Abel Wolman, who has served as Vice-President for the past year. Mr. Wolman's activities, services and affiliations, too numerous to mention completely, have made him one of America's best known authorities on water works and sanitation.

He was born in Baltimore in 1892, studied at Johns Hopkins University and was graduated in Arts in 1913 and Engineering in 1915. In 1914 he received an appointment as Assistant Engineer in the U.S. Public Health Service. In 1922 he became Chief Engineer of the Maryland Department of Health, remaining in this position until 1939. He has been Professor of Sanitary Engineering at Johns Hopkins since 1938 and has lectured at Harvard, Princeton, Southern California and Chicago Universities. He has served as Consulting Engineer to the cities of Baltimore, Portland, Ore., Richmond and Chicago; to the states of Pennsylvania and New Jersey; and to numerous governmental organizations such as the U.S. Engineers Corps, U.S. Public Health Service and the Tennessee Valley Authority. Other service includes that of Acting State Director for Maryland and Delaware for the Federal Emergency Public Works Administration, Chairman of the Maryland State Planning Commission and Maryland Water Resources Commission, and Chairman of the Water Resources Committee of the National Resources Commission.

Prof. Wolman has been a member of the A.W.W.A. since 1918 and was Editor of the JOURNAL from 1922 until 1937. He was awarded the Diven Medal in 1937 and has served as Director for the Four States Section in 1940–42.

Samuel B. Morris, Dean of the School of Engineering and Executive Head of the Department of Civil Engineering of Stanford University, is the new Vice-President of the A.W.W.A. He was born in 1890, studied at Throop Polytechnic Institute, then attended Stanford University from

(*Continued on page 6*)



Water Reserves are Vital

Waterworks systems with adequate storage facilities are meeting the increased needs of war-time activities. Installations like the 2,000,000-gal. standpipe illustrated above are justifying the foresight of their designers every day. It holds one-sixth of the storage that the Plainfield-Union Water Company has distributed throughout the eighteen cities, towns and boroughs it supplies with water.

CHICAGO BRIDGE & IRON COMPANY

BIRMINGHAM CHICAGO DETROIT WASHINGTON
PHILADELPHIA NEW YORK HAVANA CLEVELAND
SAN FRANCISCO HOUSTON TULSA GREENVILLE

(*Continued from page 4*)

which he received the degrees of A.B. and C.E. in 1911. After graduation he became Engineer for the North Pasadena Land and Water Co. and a year later he became associated with the Pasadena Water Dept. as Assistant Engineer. In 1913 he was made Chief Engineer and served in that position for 22 years. One of his achievements at Pasadena was the design and construction of "Morris Dam" which is 328 ft. high and was dedicated in 1934. In 1935 he went to Stanford University as Professor of Civil Engineering and Executive Head of the Department In 1936 he became Dean. He has been active as a Consulting Engineer, and in 1936–37 served as Water Consultant to the National Resources Committee.

Dean Morris has been an A.W.W.A. member since 1920 and has long been an active force in both the California Section and the A.W.W.A. as a whole. He was Secretary-Treasurer of the California Section in 1923–25, Vice-Chairman in 1926, Chairman in 1927 and a Director in 1931–33. He has been active on numerous Association committees and was awarded the Diven Medal in 1933.

British practice now is to use a solid stream rather than a spray in dealing with incendiary bombs, according to the June N.F.P.A. "News Letter." The spray is still considered preferable if there is only one bomb in the immediate vicinity; but a solid jet is now recommended where large numbers of bombs are dropped and many fall in a single building. In the latter case, the spray is considered too slow and the slight additional risk of injury by molten magnesium scattered by the jet is worth taking. The solid stream permits fighting the bomb from a greater distance, thus reducing the danger from any explosive charge in the bomb.

Fabricated concrete reinforcing bars were price fixed beginning June 15 by the Office of Price Administration. The cost of bars to the fabricator is generally fixed at $1.90 per 100 lb., exclusive of freight. The fabricator is allowed $0.50 per 100 lb. over and above the cost to him, freight again excluded. The consumer absorbs the freight in all cases. There are differentials for certain areas such as the Pacific Coast, Gulf ports and Michigan.

The Federation of Sewage Works Associations meeting originally scheduled for the Statler Hotel in Cleveland, October 15–17, has been postponed one week to October 22–24.

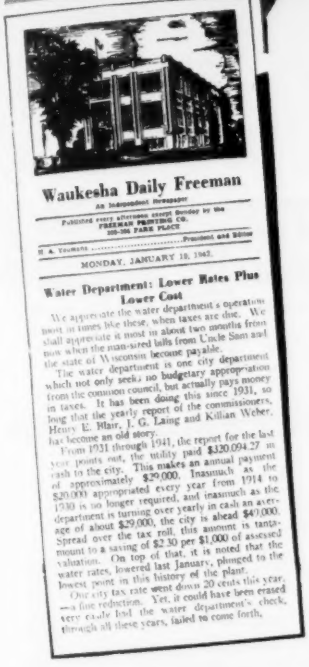
"Preventing Cutting and Welding Fires" is a booklet recently issued by the National Fire Protection Assn., 60 Batterymarch St., Boston. It contains detailed rules for safe operating procedure and illustrations of hazards and results. Single copies cost 10 cents.

(*Continued on page 8*)

IMPROVED METER MAINTENANCE

Cuts water rates $11,000 A YEAR

LOWERS CITY TAX RATE TOO!



Waukesha Daily Freeman

An Independent Newspaper

Published every afternoon except Sunday by the FREEMAN PRINTING CO. 209-211 PARK PLACE

H. A. YOUMANS ..... President and Editor

MONDAY, JANUARY 19, 1942

Water Department: Lower Rates Plus Lower Cost

We appreciate the water department's operation most in times like these, when taxes are due. We shall appreciate it most in about two months from now when the man-sized bills from Uncle Sam and the state of Wisconsin become payable.

The water department is one city department which not only seeks no budgetary appropriation from the common council, but actually pays money in taxes. It has been doing this since 1931, so long that the yearly report of the commissioners, Henry E. Blair, I. G. Laing and Killian Weber, has become an old story.

From 1931 through 1941, the report for the last year points out, the utility paid $320,094.27 in cash to the city. This makes an annual payment of approximately $29,000. Inasmuch as the $20,000 appropriated every year from 1914 to 1930 is no longer required, and inasmuch as the department is turning over yearly in cash an average of about $29,000, the city is ahead $40,000. Spread over the tax roll, this amount is tantamount to a saving of $2.30 per $1,000 of assessed valuation. On top of that, it is noted that the water rates, lowered last January, plunged to the lowest point in the history of the plant.

Our city tax rate went down 20 cents this year, —a fine reduction. Yet, it could have been erased —very easily had the water department's check, through all these years, failed to come forth,

Due in no small measure to special attention to water meters, Waukesha, Wisconsin, established the lowest water rates in the history of the City Water Works. For the $2 minimum quarterly charge, the customer can now use 8,000 gallons of water instead of 6,700 gallons.

Waukesha has a definite plan of testing and repairing water meters—testing meters when bought, testing when brought in for repairs, testing after repairs are made; with the emphasis on small flows. Repairs are made to bring 5/8" meters up to 95% or better on 1/4 g.p.m. It costs only 24.2 cents per meter for materials on 229 meters which were in service an average of 73.5 months each before tests and repairs were made.

NEPTUNE METER COMPANY • 50 West 50th Street • NEW YORK CITY

Branch Offices in CHICAGO, SAN FRANCISCO, LOS ANGELES, PORTLAND, ORE., DENVER, DALLAS, KANSAS CITY, LOUISVILLE, ATLANTA, BOSTON.

NEPTUNE METERS, LTD., LONG BRANCH, ONTARIO, CANADA

(near Toronto)

(*Continued from page 6*)

"Emergency Alternate" specifications for fire hose were developed by the Underwriters' Laboratories after considerable experimentation and research, when earlier this year the War Production Board ordered the amount of new rubber which could be used in hose reduced from about 17 lb. to a maximum of 7 lb. per 100 ft. in 2½-in. size, and correspondingly in other sizes. Hose conforming to the emergency alternate specifications probably will not last as long, according to a statement by the Underwriters' Laboratories. Burst pressures for the new hose in 1½-, 2½-, 3- and 3½-in. sizes, double jacketed, remain at 600 psi. New methods of testing have been devised, chiefly using an oxygen bomb accelerated aging test instead of relying so completely on heat tests. Here is a fine example of revision of standard specifications to meet wartime critical materials supply requirements and at the same time to maintain the necessary performance of equipment under emergency conditions.

"Retirement Plans for Public Employees" tells how to establish and operate a retirement system including methods of financing and form of administration. It is a 12-page booklet, costing 25 cents from the Municipal Finance Officers Assn., 1313 East 60th St., Chicago.

(*Continued on page 10*)

M H

HIGH QUALITY
VALVES
HYDRANTS

M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.

Peerless Pumps

America's largest selling pumps—for all services in all industries . . .

Ask for Literature



TURBINE, HI-LIFT AND HYDRO-FOIL TYPES all forms of drive—capacities from 10 to 100,000 g.p.m.

PEERLESS PUMP DIV.—Food Machinery Corporation

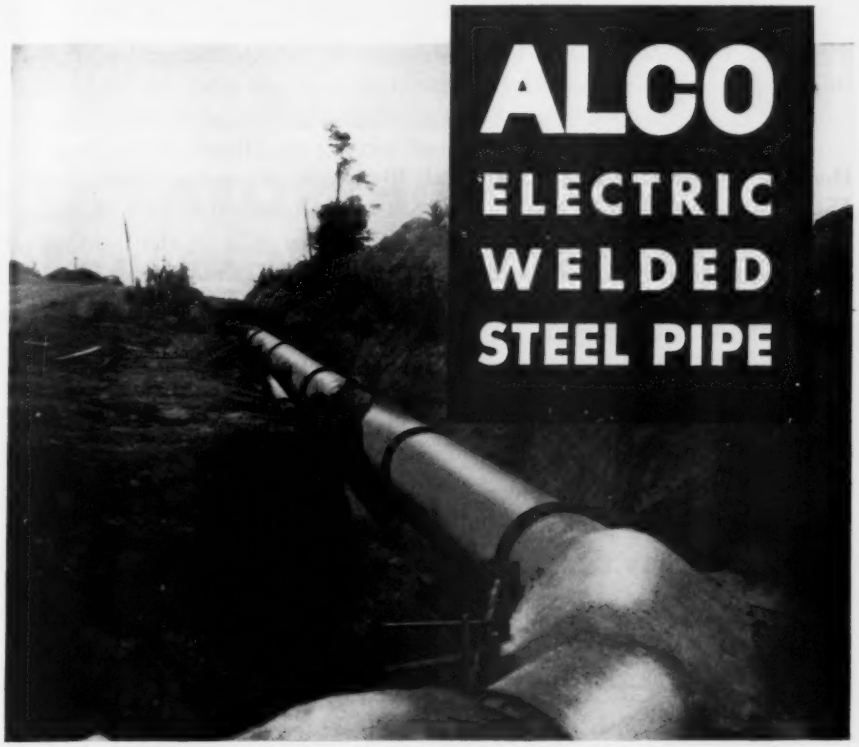
Factories: Los Angeles, San Jose, Fresno, Calif. and Canton, Ohio

Filter Sand and Gravel

WELL WASHED AND CAREFULLY GRADED TO ANY SPECIFICATION.
PROMPT SHIPMENT IN BULK OR IN BAGS OF 100 LB. EACH.

Inquiries Solicited.

Northern Gravel Co.
P. O. Box 307, Muscatine, Iowa



Alco electric welded steel pipe fabricated in accordance with the latest improved methods is highly resistant to sudden shock and rupture. Alco pipe is low in initial cost and designed for long life.

BUY ALCO
AND AVOID EXPENSIVE REPAIRS

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(*Continued from page 8*)

H. E. Lordley, formerly Plant Manager at the Richmond, Va., Filtration Plant, is now serving as a Lieutenant, U.S. Army, stationed in Hawaii.

Raymond I. Leland, who has been serving the Illinois State Dept. of Health and been stationed at Freeport, Ill., headquarters for Public Health Dist. No. 3, has been commissioned a 1st Lieutenant in the U.S. Army Sanitary Corps. He has been assigned to active duty in the position of Post Sanitary Inspector and Officer in Charge of Mosquito Control, Fort Sill, Okla.

Albert H. Hooker Jr. of the Hooker Electrochemical Co., Tacoma, Wash., is now serving as Lieutenant Colonel, Chemical Warfare Service, Washington, D.C.

Thomas H. Judd, Engineer, Washington Water Power Co., Spokane, is now in active duty as a Captain, U.S. Army Air Corps, Giger Field, Spokane.

Hayse H. Black, formerly Assistant Sanitary Engineer, Illinois State Dept. of Health, stationed at Springfield, Ill., is now in service as 1st Lieutenant, The Engineer Board, Fort Belvoir, Va.

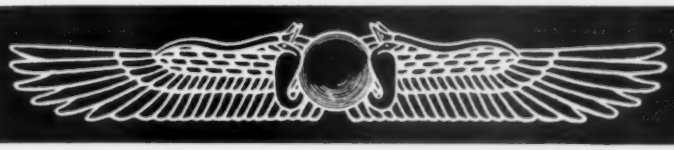
Rolf Eliassen, Associate Professor of Sanitary Engineering, New York University, has been commissioned as Captain in the U.S. Army Sanitary Corps and placed in charge of the sanitation work in the New York area.

A. E. Williamson, Acting Chief Sanitary Engineer, Florida State Board of Health, was called into active duty with the U.S. Army Sanitary Corps, effective May 30.

A new "Victory" packing called "Fibrex" has been announced by Hydraulic Development Corp., 50 Church St., New York, N.Y. Dry braided Fibrex is designed to take the place of braided jute used with self-calking compounds employed to joint cast-iron bell and spigot water mains.

Fibrex has a water repellent core and strong woven paper covering which packs into a joint in exactly the same manner as braided jute. Fibrex has all the advantages of braided jute and present evidence indicates that it will not breed bacteria. Fibrex is lighter in weight than jute and only 70 per cent of the usual number of pounds is required. Fibrex is made in $\frac{3}{8}$-, $\frac{1}{2}$- and $\frac{5}{8}$-inch sizes and prompt shipment from stock can be made.

(*Continued on page 12*)



WORTHINGTON
EQUIPMENT FOR WATER SUPPLY

CENTRIFUGAL PUMPS	STEAM AND POWER PUMPS
TURBINE WELL PUMPS	SUMP AND DRAINAGE PUMPS
DIESEL ENGINES	GAS ENGINES
STEAM CONDENSERS	CONDENSER AUXILIARIES
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MOORE STEAM TURBINES	SPEED CHANGE GEARS

●

WATER PURIFICATION EQUIPMENT
Water Softeners Pressure Filters

●

WATER METERS

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

WORTHINGTON PUMP AND MACHINERY CORPORATION
WORTHINGTON-GAMON METER COMPANY
General Offices: HARRISON, NEW JERSEY *District Offices and Representatives in Principal Cities*

IC1-21

(*Continued from page 10*)

L. S. Vance is now a Lieutenant Colonel in the U.S. Army Air Corps, stationed at Maxwell Field, Montgomery, Ala. He was formerly Chief Engineer and Superintendent for the Louisville (Ky.) Water Co.

Gilbert Frith, Assistant Engineer, Division of Sanitary Engineering, Georgia Department of Public Health, has been commissioned a Captain in the U.S. Army Sanitary Corps and is stationed at Lawson General Hospital, Atlanta, Ga.

N. M. De Jarnette, Engineer of Water and Sewage for the Georgia Department of Public Health, has been made Acting Associate Director and is in charge of the Division of Public Health Engineering.

Fred W. Hartmann of the Pittsburgh Equitable Meter Co. is now serving as a Captain in the U.S. Army Corps of Engineers. He is stationed at Chicago.

Frank A. Barbour, Consulting Hydraulic and Sanitary Engineer, Boston, is engineer for the construction of pipe lines in the expansion of the Portsmouth, N.H., water wystem. This is a Federal Works Agency project involving approximately $93,000.

Roger C. Higgins left the position of Chief Chemist, Chillicothe (Mo.) Municipal Utilities, to take up on June 18 the duties of Chemist, Board of Public Works, Hannibal, Mo., where he succeeds E. E. Wolfe.

Rudolph A. Siegmund, former Filter Plant Operator, Tonawanda, N.Y., is now serving as 2nd Lieutenant, 305th Engineer Battalion (C), Camp Forrest, Tenn.

Omega Machine Co., Inc., early in June moved to new offices and factory located at 3409 East 18th St., Kansas City, Mo.

(*Continued on page 14*)

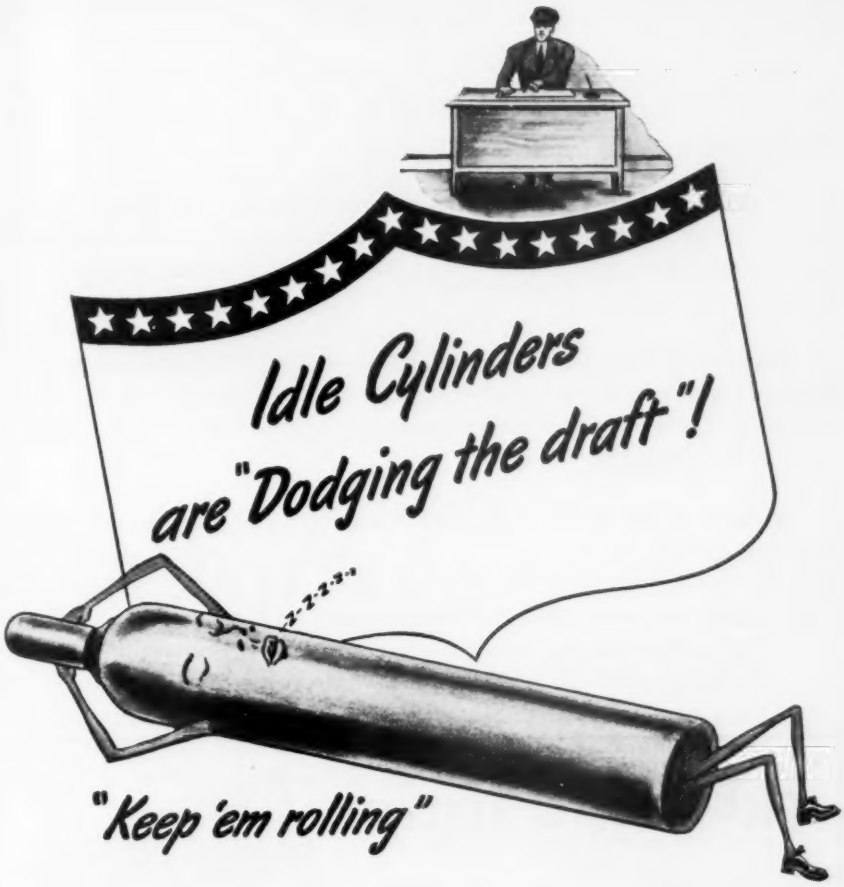
NIAGARA IRON CASE WATER METERS



provide wartime copper conservation plus the time-proved Niagara design. They comply with victory-meter limitations. Works are interchangeable with American Bronze Case Meters.

WRITE FOR CATALOG.

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.



● "Deferments" for chlorine cylinders are out for the duration. To conserve steel for Uncle Sam's tanks and battlewagons, the existing supply of cylinders has got to do full-time duty. Mathieson and the chlorine industry can't count on new cylinders "as usual."

Do your part by returning your "empties" quickly... regularly. You'll be helping Mathieson to maintain a dependable supply of chlorine for your plant. Don't let idle cylinders "dodge the draft"..."Keep 'em rolling!"

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60 EAST 42ND STREET NEW YORK N Y

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

(*Continued from page 12*)

Howell Reece of Chicago's Division of Water Works Design is now in service as Lieutenant-Commander, U.S.N.R., Ship Repair Unit, San Diego, Calif.

Frank K. Quimby, Construction Engineer, Racine, Wis., Water Dept., is now in War Dept. service as Sanitary Engineer at Chicago in charge of Sixth Corps Area maintenance and repair of water works and sewerage systems.

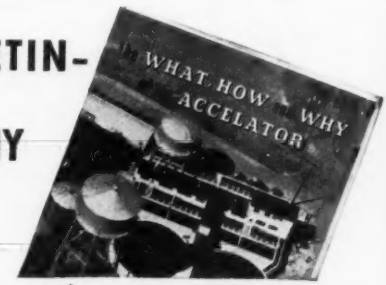
Howard J. Sowden, formerly Junior Chemist of the Minneapolis Water Dept. at its Fridley Softening Plant, is Engineer in Charge of the Softening Plant of the Federal Cartridge Corp. Twin City Ordnance Plant, New Brighton, Minn.

Richard A. Bardwell, employed in the railroad field service of the National Aluminate Corp., had the professional degree of Chemical Engineer conferred upon him in June by the University of Florida, for work done in the treatment of railroad water supplies.

(*Continued on page 16*)

FREE USEFUL BULLETIN—

The WHAT, HOW and WHY of the ACCELATOR



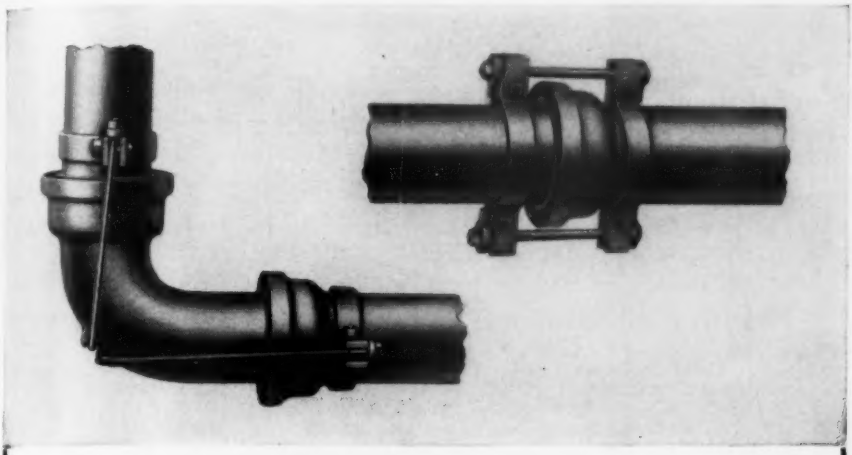
Here's a brand new bulletin, straight from the printer, that completely explains every detail and aspect of Infilco's outstanding, high-performance Softener-Clarifier,—the *Accelator.*

If you have a baffling water treating problem, this bulletin may give you the answer. It's well-illustrated and contains complete operating data on 12 case histories of average installations, many of which are similar to your plant.

Write for "The What, How and Why of the Accelator," today! Your copy of this new bulletin will be mailed promptly.

INFILCO
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FORMERLY
INTERNATIONAL FILTER CO.
325 W. 25TH PLACE, CHICAGO, ILL.



Timely

MAINTENANCE SAVERS!

Man-power is too scarce these days to waste on exploration and digging for leaks caused by needless loosening of underground joints. Save this costly maintenance by laying your pipes with Grinnell Socket Fittings and Grinnell Socket Clamps. Every joint will be permanently *locked against leaks!*

Grinnell Steel Socket Clamps are protected against corrosion by durable coal-tar-pitch varnish. Available in Friction Types, as well as Positive Types for use on Grinnell Socket Bends equipped with convenient lugs. Wide range of lengths and sizes to handle any joint.

Specify Grinnell Socket Fittings with Grinnell Socket Clamps .... provide joints that *stay* tight without maintenance! Write for complete Catalog. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities.

SOCKET FITTINGS BY

GRINNELL

WHENEVER **PIPING** IS INVOLVED

(*Continued from page 14*)

Harvey E. Wirth, Assistant Sanitary Engineer, Wisconsin State Board of Health, has been commissioned 1st Lieutenant and stationed at Harding Field, Station Medical Detachment, Baton Rouge, La.

Albert H. Stevenson, formerly an Assistant Engineer in New York City, is now serving as Assistant Sanitary Engineer (R), U.S. Public Health Service and is stationed in New York.

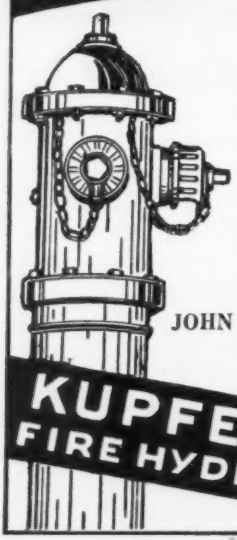
"Warfare gases merit your respect; but your fear is unjustified." This is the opinion of a man whose entire professional life for the past 17 years has been spent in public health work and in chemical safety promotion.

L. L. Hedgepeth, Manager of Technical Service for the Pennsylvania Salt Mfg. Co., is the author of the above statement in a study entitled "Warfare Chemical Hazards." It is a reprint of an informal lecture given by the author before air raid wardens in Delaware County, Pa.

Mr. Hedgepeth discusses gas warfare from the standpoint of civilian defense protective measures. The effects of gas are discussed and the

(*Continued on page 18*)

KUPFERLE
FIRE HYDRANTS



PLAN now for the protection of tomorrow. Ask for specification sheets of the Kupferle line of Fire Hydrants.

JOHN C. KUPFERLE FOUNDRY CO.
ST. LOUIS, MO.

KUPFERLE
FIRE HYDRANTS

"STOP"
says
RUSTA RESTOR
TRADE MARK REGISTERED
PATENTED PATS. PEND.
to
RUST IN STEEL TANKS
Rusta Restor is the positive method of preventing rust in all types of steel tanks and riser pipes (the electrical method)
RUSTA RESTOR CORP.
1440 W. State Street
FREMONT OHIO



Calgon TAKES THE TEETH OUT OF CORROSION

HOW to tame corrosion's bite and overcome "red water" have been stubborn problems for water works operators. Adding alkali to increase pH, for the purpose of laying down a protective scale coating, usually resulted in excess scale deposits near the plant and little, if any, protection at the ends of the lines. Operators were constantly striving for complete stability—freedom from corrosion on one hand and minimum scale on the other.

Calgon works a "pincers" attack on the problem. By laying a thin phosphate film over all metal surfaces, Calgon reduces oxidation to a minimum, at the same time preventing undesirable deposition of calcium carbonate. Thus Calgon works in lime-soda softened water as well as in naturally soft water. "Red water" quickly disappears even at the extremities of the line.

In solving the corrosion problem, Calgon gives you a bonus of longer pipe life. This is important today as pipe is becoming increasingly difficult to get. Only 1 to 5 ppm. of Calgon are needed for the most severe cases of corrosion. This brings the cost of the treatment well within the budgets of most water works departments.

We'll gladly send you complete details with instructions and a sample of Calgon* to conduct your own tests. Just write.

**Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products.*

Calgon SOLVES 4 WATER WORKS PROBLEMS

1 Prevention of scale from hard, high-bicarbonate waters. Calgon, added at the plant, prevents scale formation in mains, meters and hot-water heaters throughout the system.

2 Corrosion Control—Calgon forms a thin protective film on metals and metal oxides at pH values of 5.0 and higher. This reduces the attack of oxygen to such an extent that corrosion ceases to be a problem.

3 Prevention of "red water"—Calgon prevents the precipitation of dissolved iron. Thus "red water," either from iron initially present in well water or from corrosion, can be eliminated.

4 Stabilization of water following lime or lime-soda softening. Calgon's ability to prevent precipitation of calcium carbonate stabilizes water to the ends of the system.

calgon, inc.
HAGAN BUILDING PITTSBURGH, PA.

(*Continued from page 16*)

article also names the principal war gases, describes their characteristics and suggests first aid treatment for victims. The study voices a note of reassurance, giving the civilian a calm, non-technical understanding of what actually is involved in gas warfare.

The study appears as a supplement of "The Laundry Bundle," published by the company for May, 1942. A limited supply of reprints is available for interested persons, from the Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.

C. W. Smedberg, City Manager, Greensboro, N.C., has been appointed North Carolina Consultant, Civilian Defense Board Member, for the Fourth Corps Area.

Leeds & Northrup Company has just issued "Modern Precision" which is a 16-page booklet with pages $10\frac{1}{2}$- x $15\frac{3}{8}$-in. in size. The booklet gives general and detailed information on electrical instruments, controls and furnaces and is available from the Company at 4934 Stenton Ave., Philadelphia.

(*Continued on page 20*)

STOP RUST
with
RUSTOP



Cathodic Protection ends rust
●
Cleans old tanks
●
Keeps new tanks clean
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No paint—No taste
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Write for estimate

ELECTRO RUST-PROOFING Company
29 W. Apple Street
Dayton, Ohio

VOGT FIRE HYDRANTS

Standard—
"Traffic Model"—
Flush Type—
Water Crane Type



VOGT GATE VALVES



Non-Rising Stem—Outside Screw and Yoke—Hub End—Flanged End—Ends to Fit any Type Pipe.

Also—Floor Stands, Shear Gates — Tapping Sleeves and Valves, Flap Valves and Mud Valves.

VOGT BROTHERS MFG. CO.
INCORPORATED
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A MESSAGE TO ALL GENERAL CHEMICAL ALUMINUM SULFATE USERS



2 Half-filled Cars = 1 Full Car + 1 EMPTY CAR
FOR WAR SHIPMENTS

ORDER "MAXIMUM" CARS!

Everyone knows the railroads are operating under abnormally heavy war-time traffic demands . . . and everyone wants our war materials to have not only "right of way," but all possible transportation facilities instantly available!

You can help in this situation by ordering your future requirements in "maximum" car lots. This will immediately conserve transportation space and reduce the haulage necessary to serve your needs!

Another patriotic step that users of General Chemical "Alum" can take is to order their requirements in paper bags instead of in burlap, thus conserving dwindling supplies of essential jute!

LET'S ALL HELP IN EVERY POSSIBLE WAY!

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GENERAL CHEMICAL COMPANY
40 RECTOR STREET, NEW YORK, N. Y.

Offices: Atlanta • Baltimore • Boston • Bridgeport (Conn.) • Buffalo Charlotte (N. C.) • Chicago • Cleveland • Denver • Detroit • Houston Kansas City • Milwaukee • Minneapolis • New York • Philadelphia Pittsburgh • Providence (R. I.) • St. Louis • Utica (N. Y.)
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(*Continued from page 18*)

OHIO SECTION MEETING

There was considerable speculation and a good deal of worry on the part of the Convention Arrangement Committee as to how many could be expected to register at the 1942 meeting of the Ohio section. In 1940 the registration was 198. In 1941 it was 141. The effect of transportation problems and the more or less general attitude of retrenchment due to the war and living costs could not be estimated, and it was a great surprise when the registration passed that of last year by 7 registrants. Of this number, 23 were visiting ladies.

The visit to the new Toledo water purification plant probably influenced some to attend the meeting. Quite a number of men came from Michigan.

The program was opened on Thursday morning with the usual formality of receiving the keys to the city from Vice-Mayor Roulet. Following his greeting, the Toledo water department division heads described the Toledo water works in a manner similar to that first employed at Akron at the 1940 meeting.

R. W. Furman, water commissioner, gave "The History of Toledo Water Works." Toledo was incorporated in 1838. From then until 1872 water was obtained from wells and cisterns. There was no public supply during this period. In 1870 Lake Erie was investigated as a source, but the Maumee River was decided upon for reasons of economy. A filter, installed in 1878, employed a method of passing water upward through compressed sponge, then upward through gravel, sand and granulated charcoal. This filter was unsuccessful and was abandoned.

Pumping capacity was increased from time to time until in 1894–95 two 15-mgd. Worthington pumps were installed. One of these units was displayed at the Columbian Exposition in Chicago as its largest and most efficient steam pump. This equipment is still in standby service.

Not until 1910 was Toledo served with filtered water. The 20-mgd. plant installed at that time was increased from time to time so that its capacity since 1921 has been 56 mgd. This plant served the city until February 1942, when the new Lake Erie plant was put into full operation.

(*Continued on page 22*)

ZECO GREENSAND ZEOLITE

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZEOLITE CHEMICAL CO.
90 WEST STREET NEW YORK, N. Y.



People used to say you could save shoe leather by taking long steps...

Today with proper priorities you can "take long steps" on war-time supply lines and force mains by using 50-foot sections of ARMCO Spiral Welded Pipe. Long lengths mean fewer joints, less assembly work. You save the difference.

Once the line is installed you'll find that leakage loss is low. Strong, tight joints are attained with any type of coupling or by field welding. A smooth spun enamel lining prevents tuberculation and recurrent cleaning troubles. It also assures *continued* high flow capacity. Pumping costs never get out of hand.

ARMCO Pipe, of course, is shatterproof . . . which is mighty good insurance in these perilous times. Its ultimate strength is 50,000 to 60,000 lbs. per square inch, and it stretches 25 to 30 per cent before breaking. Diameters run from 6 to 36 inches; wall thicknesses from 9/64 to 1/2-inch. Write us direct for prices and shipping promises. The American Rolling Mill Co., Pipe Sales Div., 411 Curtis St., Middletown, Ohio.

ARMCO ARMCO **SPIRAL WELDED PIPE**

(*Continued from page 20*)

Owen E. Clark, division engineer, described "The New Lake Erie Water Supply." The plant, begun in 1938, was put into continuous operation on January 9, 1942, and was in full operation about a month later.

Albert L. Kruger, Chief Chemist and Bacteriologist, described "The Flexibility of the New Water Plant." The chemical mixing basins and sedimentation basins are so arranged that great flexibility in treatment is provided. Any of the four units into which the plant is divided may be operated independently. The sedimentation basins are equipped with continuous sludge removal devices and treatment for softening may be applied in case it is desired. There are 20 filters, each of 4-mgd. capacity, arranged in two independent sections. They are provided with Wheeler bottoms and have a grid system of pipes which provides surface wash. The rate controllers are automatically manipulated.

E. R. Barrett, Office Manager, spoke on "Office Administration." Under this title he described methods employed in the Toledo office: "Contracts for Water," "Billing," "Cash Accounting," "Collections" and "Meter Ownership."

(*Continued on page 26*)

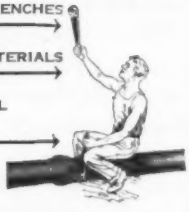
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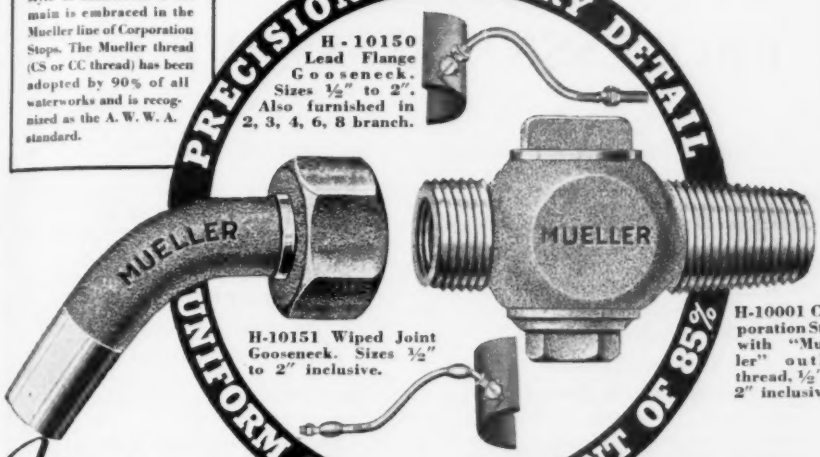
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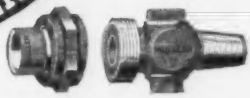
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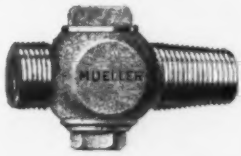
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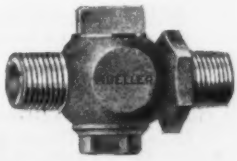
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WATER WORKS - SEWERAGE - UTILITIES
Baltimore, Md. — Albany, N. Y.

(*Continued from page 22*)

Ralph E. Reed, deputy commissioner, gave the details of the construction, tapping and meter departments as operated by the Division of Water in Toledo.

The first afternoon session was opened by the Association Secretary, Harry E. Jordan, who gave a talk on "The Part the A.W.W.A. Can Play in the Present Emergency."

There are many new problems of a critical nature which confront the water works man. The Association is making every effort to solve these problems and to be of service to all, whether members or not. "No one," he said, "will be excluded in measures of assistance, but all alert water works men should be in the Association. It is on the firing line."

A critical list of water works employees is to be given to local draft boards, indicating to the boards the men who are in positions of essential civilian activities. The group deferment of water works men is now regarded as necessary, he said.

He spoke of the short-sighted policy of leaving meters out of defense housing projects. With no meters, consumption of water increases and requires a 25 per cent increase in metal demand. The metal demand

(*Continued on page 28*)

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EVERYWHERE Americans are being asked to "SAVE FOR DEFENSE." Water works superintendents, engineers and public officials can do more in this connection by investigating the National Method of water main cleaning. This method restores the carrying capacity of pipe to at least 95 per cent of that of new mains, thereby eliminating the necessity for purchase of new mains. Aside from this the National Method makes possible lower pumping costs, greater delivery, reduced insurance rates and clean water.

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Ronald Harrison, Manager Public Utilities Commission, Scarborough Township, Ont., describes in WATER AND SEWAGE changes made to eliminate possible water failure. A 2000-Imp. g.p.m. De Laval pump for 210 ft. head, with a De Laval Automatic Priming System, was selected because it met all the exacting requirements, namely:

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6– "Proper adjustment of the packing glands is also simplified, as the pump casing and suction line are not primed under pressure."

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(*Continued from page 26*)

for meters is a very small percentage of the whole. Defense housing could also save considerable metal if these developments were located on and served with water mains instead of on property beyond the water and sewer lines.

In the civil defense program the water works man should tend to his water works job and stay out of other civil defense activities. People should be made to understand that his position is important. The water works man should sit on defense councils. He should have his department organized for repairing damage which may be caused by bombs. Most of the damage to British water works has been to the distribution system. A study of the British problem and means of handling it was suggested.

W. H. Knox, Assistant Engineer, State Department of Health, gave "The High Lights of Investigations of Protection of Public Water Supplies in Ohio." Investigations of 75 cities and 16 villages have been made since January 1. He spoke briefly of measures taken such as fencing, guards, lighting of water works structures. He emphasized the appalling lack of water works records in a large number of municipalities. Very few plants have accurate maps of the distribution system showing sizes of

(*Continued on page 30*)



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(Continued from page 28)

mains, location of valves, etc. He pointed out that such information was indispensable when water mains are broken. He advised against the tendency to permit laymen to operate valves on the distributing system even in a case of emergency.

Inventories of spare water works equipment have been furnished to the State Department of Health by about 75 municipalities. The survey also revealed that practically all industries are engaged, either directly or indirectly, in war production, and the public water supply is a most important factor in the war effort.

Frank B. Thomas, Deputy Supervisor, Bureau of Inspection and Supervision of Public Offices, gave a paper entitled "How the Examiner Looks at the Water Works."

"The State Examiner looks at a water works as a business proposition," Mr. Thomas stated. He discussed three elements of that business: (1) cost of production and distribution, (2) revenue collection and (3) record keeping and reporting.

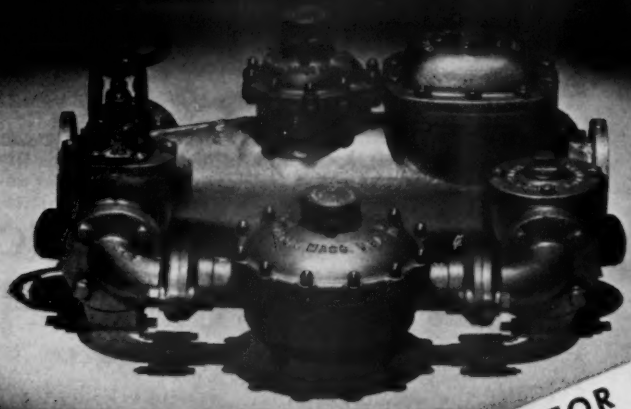
Under the first heading he pointed out that often little consideration is given to the loss of water in distribution. This is an element of cost. Depreciation of pipe lines, meters, etc. and a portion of overhead should be allocated to distribution costs.

(Continued on page 32)

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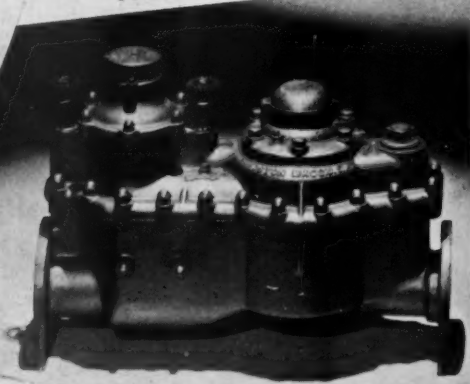
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(*Continued from page 30*)

Under the second heading, "revenue collection," he favors the three-district plan for billing, so that one-third of the consumers are billed for a three months' period in one month, another third the second month, and the remaining third the third month. This system provides a constant flow of revenue. He discussed the details of keeping the records of accounts of consumers as well as an accurate record of miscellaneous accounts, such as records of taps and service connections.

The third element, "record keeping and reporting," emphasized the need for business-like methods of handling and distribution of materials. He recommended the use of a central warehouse or stores account. Many water works do not maintain inventories of materials and supplies. Many water works officials have little or no knowledge of the financial status of works until the examiner shows them that they are losing money.

Municipally owned utilities have not been bothered much with profit and loss in the past. If a new plant is needed, they go to the voters. Long distribution lines are laid without regard for the revenue from these lines. Delinquent accounts have been of little concern. "If you don't soon begin to operate your plant efficiently, there may soon be no plant to operate. In other words, you have been superseded as a borrower by Uncle Sam," he said.

James E. Specht, Superintendent of Utilities at Orrville, gave a paper entitled "Surface Washing of Filters." The Orrville water softening plant is of the lime-soda type, treating well water. There are three filters, 6 x 10 ft. in plan, installed in 1939. The sand became incrusted shortly after the plant started operation. Two inches of sand had to be discarded every three or four weeks to keep the sand level at the original elevation. Palmer filter washing devices were installed on all filters in January 1941. Growth of sand has decreased greatly. Removal of sand now is at the rate of not over 2 in. in four months. During this period there has been a 44 per cent increase in water production. No reduction in the amount of wash water

(*Continued on page 36*)

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Adams, John W., Supt., Carlinville Water Works System, 920 Johnson St., Carlinville, Ill. (Apr. '42)

Bevington, F. E., Supt. of Water Dept., 725—32nd St., Milwaukee, Ore. (Affil. Jan. '42)

Brigg, Earl, Water Supt., Water Dept., Grandview, Wash. (Apr. '42)

Bryan, John G., Water Plant Operator, New Jersey Conference Camp Meeting Assn., 58 Simpson Ave., Pitman, N.J. (Apr. '42)

Bryson, Carlyle H., Supt., Water Div., Utilities Dept., Utilities Bldg., 18–20 S. Nevada Ave., Colorado Springs, Colo. (Apr. '42)

Burdick, Oliver, Supt., Public Service Div., City Hall, Niagara Falls, N.Y. (Apr. '42)

Bush, Wesley A., Owner, Parker Water Works Co., Parker, Ariz. (Apr. '42)

Catton, W. R., Mgr., Public Utilities Com., Brantford, Ont., Can. (Apr. '42)

Chenal, William J., Engr., Cincinnati Water Works, 3521 Schwartze Ave., Cincinnati, Ohio (Apr. '42)

Christy, Clyde V., Water Supt., Warrenton, Ore. (Apr. '42)

Dye, C. K., Sales Engr. & Dist. Mgr., Pomona Pump Co 372 Arden Rd., Columbus, Ohio (Apr. '42)

Everson, J. E., *see* Princeton Water Dept.

Fanella, Daniel, Supt., Water Dept., 11 Elmwood Parkway, Elmwood Park, Ill. (Apr. '42)

Fischer, Joseph C., Chief Engr., Milwaukee County Institutions, Wauwatosa, Wis. (Apr. '42)

Fischer, N. J., Supt., Water & Light Dept., 302 Racine St., Jefferson, Wis. (Apr. '42)

Fisken, James B., Water Engr , Whitehouse & Price, 2731 Gardner Ave., Spokane, Wash. (Affil. Jan. '42)

Foster, William S., Eng. Editor, *The American City,* 470 Fourth Ave., New York, N.Y. (Apr. '42)

Gedge, F. G., Supervisor, Wyoming Water Works, 500 Grove Ave., Wyoming, Ohio (Apr. '42)

Gouge, Charles C., Chief Operating Engr. of Water Supply, Utilities, Camp Wallace, Tex. (Apr. '42)

Green, Alvin W., San. Engr., Dept. of Health, City Hall Annex, Tacoma, Wash. (Apr. '42)

Guyton, William F., Asst. Hydraulic Engr., U.S. Geological Survey, 302 Lufkin National Bank Bldg., Lufkin, Tex. (Apr. '42)

Harper, E. A., Technical Director, Brunswick Pulp & Paper Co., Brunswick, Ga. (Jan. '42)

Harris, Alfred J., Supt. of Public Works, Township of Haddon, 232 Burrwood Ave., Collingswood P.O., Camden County, N.J. (Apr. '42)

Hatch, R. L., Plant Chemist, Brunner, Mond Canada, Ltd., Amherstburg, Ont., Can. (Jan. '42)

Hauck, Charles F., San. Engr., Atlas Powder Co., Ravenna Ordnance Plant, Apco, Ohio (Apr. '42)

Hiltz, John E., *see* Wayne County Board of County Road Comrs.

Jackson, William, Supt., Water Dept., 231 Christian Ave., Hubbard, Ohio (July '42)

Jones, Myron T., Chief Engr., Water & Sewers, Scioto Ordnance Plant, 127½ N. Prospect St., Marion, Ohio (July '42)

Jones, T. Marshall, Dist. Sales Engr., M & H Valve & Fittings Co., 618 Belleforte Ave., Oak Park, Ill. (Apr. '42)

Kreuch, Paul C., Dist. Mgr., Pittsburgh Equitable Meter Co., 122 S. Michigan Ave., Chicago, Ill. (Apr. '42)

Kruger, Albert L. Chief Chemist & Bacteriologist, Filtration Plant, 2152 Brookford Drive, Toledo, Ohio (July '42)

Lessard, L. P., Mgr., Transite Pipe Sec., Johns-Manville Sales Corp., 222 N. Bank Drive, Chicago, Ill. (Apr. '42)

Lingnor, Larry H., *Water Works & Sewerage,* 330 S. Wells St., Chicago, Ill. (Apr. '42)

Maker, Leonard Alburn, Operator, Water Dept., 1615 Sutter St., Vallejo, Calif. (Apr. '42)

Miller, Frank H., Asst. Engr., Bureau of San. Eng., State Dept. of Health, Richmond, Va. (Apr. '42)

Moore, Robert E., Jr., Deputy City Attorney, Legal Div., Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles, Calif. (July '42)

Mortell, J. W., Co., A. R. Schuber, Sales Mgr., Kankakee, Ill. (Assoc. M. Apr. '42)

Musgrave, A. S. G., Munic. Engr., Corp. of Dist. of Oak Bay, Municipal Hall, Oak Bay, B.C., Can. (Apr. '42)

Nelson, Frederick G., Asst. Mgr., Sanitary Div., The Dorr Co., Inc., 1838 La Salle-Wacker Bldg., Chicago, Ill. (Apr. '42)

Ningard, Louis G., Asst. Civ. Engr., Bureau of Water Supply, 5522 Windsor Mill Rd., Baltimore, Md. (Apr. '42)

Nordholm, H. E., *see* Red Wing Board of Water Comrs.

Parks, Edward E., Operator, Filtration Plant, City Water Dept., Harlem, Mont. (Apr. '42)

Pierce, E. J., Mgr., The Marion Water Co., 195 E. Center St., Marion, Ohio (July '42)

Pingree, L. W., Wallace & Tiernan Sales Corp., 917 Terminal Sales Bldg., Seattle, Wash. (Apr. '42)

Powell, E. W., Supt. of Water Dept. & City Engr., Concordia, Kan. (Jan. '42)

Powers, E. C., Lime Sales Mgr., The Marble Cliff Quarries Co., 20 N. 5th St., Columbus, Ohio (July '42)

Price, J. Paul, Foreman, Water Dept., 411 Mahoning Ave., Warren, Ohio (July '42)

Princeton Water Dept., J. E. Everson, Supt., Water & Light Dept., City Hall, Princeton, Ill. (Corp. M. Apr. '42)

Red Wing Board of Water Comrs., H. E. Nordholm, Clerk, City Hall, Red Wing, Minn. (Corp. M. Apr. '42)

Rice, Archie H., Engr., State Board of Health, 212 Oregon Bldg., Portland, Ore. (Affil. Jan. '42)

Root, Darrell A., Director, Water Purif. Course, Enlisted Men's School, Fort Belvoir, Va. (Apr. '42)

Schuber, A. R., *see* Mortell, J. W., Co.

Schworm, William B., Sr. Chem. Engr., Supply & Purif. Sec., St. Louis Water Div., Chesterfield, Mo. (Apr. '42)

Seidensticker, F. W., Sr. Filtration Designer, Div. of Water Purif., 1006 City Hall, Chicago, Ill. (Jan. '42)

Sieveka, Ernest H., Chem. Lab., Iowa Ordnance Plant, Center Junction, Iowa (Apr. '42)

Wagner, E. G., Public Health Engr., Div. of Sanitation, State Dept. of Health, University Campus, Minneapolis, Minn. (May '42)

(*Continued on page 37*)

HOW THE SOLVAY SALES FORCE
IS HELPING
THE WAR PRODUCTION PROGRAM

Like many another manufacturer, we shifted to a war time production basis almost overnight. As a part of this program it has been necessary to curtail our sales solicitation in order to use some of our salesmen for other duties.

Other Solvay salesmen have taken over the work of those men who have been transferred. In addition, sales calls of Solvay salesmen have been "pooled" wherever possible in order that more territory can be covered with limited use of automobiles.

Perhaps, for the time being, a "new" Solvay face will be making sales contacts in your district. You can rest assured that this man knows his business . . . that he will try to be of utmost help in solving your problems.

In return for the extra hours these men are now putting in, would you try to make your Solvay salesmen's calls as effective as possible—to your advantage and to his—by promptly giving him the time he needs . . . even thinking ahead of time how you and he can work best together to save just a little more time for some other customer's problem?



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(*Continued from page 32*)

seems to have resulted from the use of the surface wash at this plant, but it has resulted in keeping the filters cleaner and in better condition, with a reduction in maintenance costs.

This subject was discussed by several water works men who have installed surface washing devices. In treating Lake Erie water at Avon Lake water works, J. C. Britton has cleaned several dead spots from the sand bed and is saving 35 per cent of the wash water formerly used.

John A. Marsh of Cleveland said that in six months after installing the surface wash in one filter, a 29 per cent reduction was noted in the acid soluble material on the sand. After 12 months' use, this had been further reduced to 48 per cent. The sand level dropped between 3 and 4 in. A 27 per cent saving in wash water also resulted. The length of filter runs was about the same. Hard spots were removed. "We are well satisfied with results," he said.

William I. Van Arnum, Superintendent of the Filtration Plant of the Mahoning Valley Sanitary District, reported that the filter sand, after 10 years' use, had grown. It shrank away from the filter walls and contained mud balls. After operating a surface washer in one filter for several months, all these conditions have been improved or eliminated. Incrustation, however, has not been noticeably reduced. Bacteria (20°C. on agar) are less than are found in other filters. After washing, the wash water has a turbidity of 30 ppm. Other filters have wash water turbidity of 60 ppm. at the end of the washing period when equal amounts of wash water are used.

R. W. Furman, Jr., described the surface washing system at Toledo. This has been in use for only four months and no tangible results obtained.

R. J. LaMarr, Detroit, Michigan, described the method of sand washing used at Detroit. Sand is moved from one part of a filter to another during the washing period by passing it through a 4-in. ejector. Operating on a slow wash, all of the sand in a filter will pass through the ejector and it will remove mud balls and clean the sand. Detroit filters, he said, are cleaned in the Spring and Fall by means of these ejectors. One filter is permanently fitted with sixteen 1-in. ejectors. Each one will handle 90 sq. ft. of sand in a wash employing 12 per cent sand expansion for 18 min. It is more economical and quite satisfactory to use a large ejector twice a year.

Raymond J. Faust, Assistant Engineer, Michigan State Department of Health, pointed out that surface washing devices constituted a cross-connection between the applied and finished water.

"Problems Peculiar to Ground Water Supplies" was presented by A. E. Kimberly, Consulting Engineer, Columbus. He gave many valuable precepts: Resistivity tests by electric methods are of much value and the cost is justified on important projects where relatively large volumes of

(*Continued on page 38*)

(*Continued from page 35*)

Wayne County Board of County Road Comrs., John E. Hiltz, Engr., 3800 Barlum Tower, Detroit, Mich. (Corp. M. Apr. '42)

Wimer, C. F., Supt., Water Dept., Hastings, Minn. (Apr. '42)

Winsinger, O. F., Sales Mgr., Rusta Restor Corp., 1422 Palmetto Ave., Toledo, Ohio (Apr. '42)

Wolfe, Lillian E. (Miss), Treas. & Asst. Secy., The Pennsylvania Water Works Assn., 510 Telegraph Bldg., Harrisburg, Pa. (Apr. '42)

Wylam, Wm. J., Supt. of Water & Light, Board of Public Affairs, 143 Grant St., Lowellville, Ohio (July '42)

REINSTATEMENTS

American Well Works, Inc., The, E. B. Rausch, Gen. Mgr., Aurora, Ill. (Assoc. M. Mar. '23)

Carter, H. E., Supt. & Mgr., Crescenta Mutual Water Co., Box 63, Verdugo City, Calif. (July '35)

Case, E. W., Supt., Water Works, Newport, Ore. (Affil. Jan. '39)

Hall, H. E., Cons. Engr., Larson Bldg., Yakima, Wash. (Jan. '36)

Rausch, E. B., *see* American Well Works, Inc.

Ross, A. W., Vice-Pres., Layne-New York Co., 246 Upper Mountain Ave., Montclair, N.J. (Jan. '36)

LOSSES

Resignations

Bernard, Hunter C., Chemist, Brunner, Mond Canada, Ltd., Amherstburg, Ont., Can. (Jan. '35)

Groves, J. N., Supt., Water Works, Canton, Ga. (May '30)

Wolfe, James O., Supt., Water Dept., Concordia, Kan. (Jan. '40)

Deaths

Sorelle, Donald, Supt. of Water Works, Acushnet, Mass. (Apr. '30)

Changes in Address

Changes in address between the A.W.W.A. 1942 Directory and June 15, 1942

Allen, Tip H., *see* Canton Munic. Utilities

American Pipe & Construction Co., Robert P. Edwards, Box 3428 Terminal Annex, Los Angeles, Calif. (Assoc. M. Oct. '17)

Basil, Helen (Miss), *see* Crane Co.

(*Continued on page 39*)



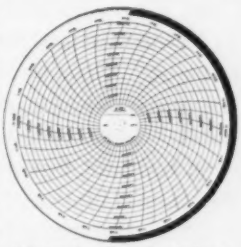
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SIMPLEX METERS
THE METER WITH THE BELL SHAPED FLOAT

(*Continued from page 36*)

ground water are required. The services of experienced geophysicists and geologists are essential.

Test wells and pumping tests are important. Observation wells are necessary to permit estimates of probable production. Reference is made to a useful porosity formula adapted to American conditions. Several methods of cleaning clogged strainers and wells are discussed, including acid and chlorine treatment. Specifications for wells should limit drawdown to insure 100 per cent effective screen area under all conditions. Well yields vary approximately as to the ratio of the logs of the diameters of the wells. Importance of awarding contracts to well drillers of experience and skill is emphasized.

"Substitute and Alternate Materials for Service Pipe" presented by E. E. Smith, General Superintendent, Department of Water and Sewage, Lima, appears elsewhere in this JOURNAL.

"Preparation, Laying, and Sterilization of Water Mains" was described by N. J. Humason, Superintendent of Filtration, Elyria Water Works. In laying new water mains, he emphasized the importance of keeping dirt out of the pipe, plugging the ends of the pipe to keep out water and dirt. The use of rubber packing instead of jute has some advantage because it is non-porous and non-absorbent, and is more easily sterilized.

Chlorine is used for sterilizing newly laid lines. Hydrated lime is sometimes added to give a high degree of causticity for sterilization. Flushing a line before sterilization is good practice.

At Elyria the line is first flushed and then chlorine is added gradually as the line is filled with water. A contact period of from 5 to 7 days is allowed. The line is again flushed and tested. If tests are satisfactory, the line is put in service. About 25 ppm. chlorine comprises the first treatment. This is increased if it is necessary to resterilize the line. In one very resistant pipe line, eight doses were given. The final one contained 600 ppm. chlorine.

L. A. Marshall of Cleveland described some problems of sterilizing old lines. One, a private distribution system in a suburb, was taken over by the city. It was sterilized readily with chlorine treatment at 25 ppm. Another line was an old fire line through which raw river water had been pumped some years ago for fire protection. Attempts to sterilize this with chlorine were unavailing, probably due to deposits of mud, etc. in the line.

W. R. LaDue, Superintendent and Chief Engineer, Bureau of Water and Sewerage, Akron, Ohio, spoke on "The Need for Good Management of Municipal Water Works." This paper was essentially a report of the A.W.W.A. Management Committee, of which Mr. LaDue is chairman. A report of this committee was also made at the annual meeting at Chicago.

Mr. LaDue pointed out that the subject of management under various topics receives more discussion among water works men than any other.

(*Continued on page 40*)

(*Continued from page 37*)

Berk, Ralph G., Designing Engr., Warren & Van Praag, Inc., Seymour, Ind. (July '41)

Canadian Engineer Publications, The, K. J. Salmond, *Water & Sewage*, 341 Church St., Toronto 2, Ont., Can. (Assoc. M. May '16)

Canton Munic. Utilities, Water Works Dept., Tip H. Allen, Supt., Box 114, Canton, Miss. (Corp. M. Jan. '39)

Clement, Russell C., 75 Overlook Terrace, Bloomfield, N.J. (July '35)

Cole, E. Shaw, Engr., 21 Erwin Park Rd., Montclair, N.J. (Oct. '38)

Crane Co., (Miss) Helen Basil, Librarian, Research Labs., 836 S. Michigan Ave., Chicago, Ill. (Assoc. M. Jan. '26)

Cross, William P., 304 N. Liberty St., Delaware, Ohio (Jan. '40)

Davis, Don C., Civ. Engr., 1649 Achor Court, Modesto, Calif. (Jan. '41)

Edwards, Robert P., *see* American Pipe & Construction Co.

Eliassen, Rolf, 114 W. 183rd St., New York, N.Y. (Jan. '35)

Foerster, Wm. K., Water Supt., Maywood Mutual Water Co. No. 2, 324 W. Valencia Ave., Burbank, Calif. (July '39)

Gray, H. M., 1628 Columbia Rd., N.W., Apt. 406, Washington, D.C. (Affil. Jan. '39)

Harper, L. E., Secy., Omega Machine Co., Inc., 3409 E. 18th St., Kansas City, Mo. (July '37)

Hasselgren, R. E., Supt., Water Filtration Plant, Folsom Prison, Box 132, Folsom, Calif. (Affil. Jan. '42)★

Hauer, Gerald E., Water Supervisor, General Chemical Defense Corp., West Virginia Ordnance Works, Point Pleasant, W.Va. (July '41)

Howell, Eugene M., % R. C. Perrin, Canopic Apts. No. 6, Muncie, Ind. (Jan. '37)

Larson, Harry, Box 86, Fort Lewis, Wash. (Oct. '41)★

Lawton, Ralph W., 4403 W. 9th St., Los Angeles, Calif. (July '06) *Honorary M. '38.*

Masters, C. P., Supt., Munic. Authority of Boro of Greenville, Greenville, Pa. (Affil. Jan. '41)

Miller, Chester A., 507 W. Oak St., Carbondale, Ill. (Oct. '41)

Miracle, Ralph, Box 11, Hot Springs, S.D. (Apr. '40)

(*Continued on page 41*)

CONSULTING ENGINEERS

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(*Continued from page 38*)

The study of the problems of management was so broad in scope that a committee of 25 was selected, representing men from many locations in the United States and Canada, representing various types and sizes of organizations. The report concludes with this statement: "Sound management cares for the needs of the present and protects and insures the hopes of the future—a truly honorable undertaking, worthy of the water works profession and a challenge to all so engaged."

"Plant Management Problems" were discussed by O. F. Schoepfle, Superintendent of Filtration, Sandusky, who pointed out the advisability of men in charge of water purification plants having at least a smattering of knowledge of several marginal fields. A knowledge of some phases of civil and electrical engineering should be valuable to a chemist and likewise a knowledge of chemistry and bacteriology would be invaluable to an engineer. Examples of the advantages of a knowledge of hydraulics, of pumps and motors whereby inefficient units can often, at slight cost, be replaced by efficient ones, were described.

An operator should be familiar with various types of metering equipment. Any type of meter requires some intelligent service if it is to be kept accurate. He closed with the suggestion that "the water plant operator should use as a hobby the study and mastery of scientific material related to his every day work."

R. D. Scott, State Department of Health, gave a paper entitled "Determination of the True Phenols Contents of Surface Waters." With increased coke oven output there has been an increased discharge of phenols into Ohio surface waters. In order to determine phenols content with any accuracy, modifications of the Standard Methods procedure were found necessary. Most important were:

1. Preservation of phenols content with copper sulfate instead of sodium hydroxide.

2. Use of a standard solution containing both o-cresol and phenol instead of phenol alone, in order to improve color matching.

(*Continued on page 42*).

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(*Continued from page 39*)

Omega Machine Co., Inc., L. E. Harper, Secy., 3409 E. 18th St., Kansas City, Mo. (Assoc. M. Jan. '30)

Renshaw, William C., Asst. Engr., Water Dept., 86 Inverness Drive, San Francisco, Calif. (Nov. '33)

Rice, John M., Cons. Engr., Century Bldg., Pittsburgh, Pa. (June '21)

Salmond, K. J., *see* Canadian Engineer Publications

Snow, Bayard F., % Office of Emergency Management, Office of Inter-American Affairs, 3622 Commerce Bldg., Washington, D.C. (Apr. '36)

Starling, Charles H., Field Engr., Infilco, Inc., 301 Hillside Ave., Charlotte, N.C. (July '38)

Taylor, Frank S., Filtration Engr., Water Dept., Municipal Bldg., Oklahoma City, Okla. (Apr. '41)

Towne, W. W., State Board of Health, Pierre, S.D. (Dec. '29)

Van Benschoten, Jay, Highland Stamping & Mfg. Co., Ltd., 1732 Berkeley St., Santa Monica, Calif. (June '23)

Wallace, Donald S., Dist. Engr., U.S. Geological Survey, Box 1338 University Station, Charlottesville, Va. (May '34)

Winslow, Edward L., Jr., U.S. Engr.'s Office, Bermuda, % Postmaster, New York, N.Y. (Apr. '30)

MEMBERS ENTERING MILITARY SERVICE

Black, Hayse H., Sr. San. Engr., State Dept. of Public Health, 1605 S. Douglas Ave., Springfield, Ill. (Oct. '33)★

Eliassen, Rolf, 114 W. 183rd St., New York, N.Y. (Jan. '35)★

Frith, Gilbert R., Asst. Engr., Div. of San. Eng., State Board of Health, Atlanta, Ga. (July '37)★

Hartmann, F. W., 941 S. Harvard Ave., Villa Park, Ill. (July '25)★

Hooker, Albert H., Jr., Hooker Electrochemical Co., Tacoma, Wash. (July '30)★

Leland, Raymond I., State Dept. of Public Health, 404 Smith Bldg., Freeport, Ill. (Jan. '39)★

Reece, Howell, Illinois Athletic Club, 112 S. Michigan Ave., Chicago, Ill. (Oct. '38)★



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WABASH, INDIANA

(*Continued from page 40*)

3. Distillation from all-glass still, adjusting volume of sample taken to compensate for single distillate collected, instead of collecting series of distillates.

Certain other refinements were presented.

The usual banquet and entertainment was attended by 146. The speaker was Judge Harvey G. Straub.

Wendell R. LaDue, Chairman of the George W. Fuller Award Committee, presented the name of Hayes R. Kuhns as the committee's choice for this year's award, with the following citation: "In recognition of his untiring efforts in promoting the advantages of the American Water Works Association and for his devoted and sustained efforts in behalf of the Ohio Section."

Officers for the ensuing year are as follows: E. E. Smith, Lima, Chairman; H. P. Jones, Toledo, Vice Chairman; Paul Cook, Painesville, Trustee, 1943; Carl Eberling, Cincinnati, Trustee, 1944; Luther T. Fawcett, Youngstown, Trustee, 1945; W. W. Morehouse, Dayton, Director; and L. J. Hoffman, Akron, Secretary-Treasurer.

The Resolutions Committee recommended a resolution, which was passed unanimously, offering the support of this Section in the maintenance of the regulations governing the classification and certification of water purification plant personnel.

THOMAS R. LATHROP
Secretary-Treasurer

"Taste and Odor Control in Water Purification" is a nicely arranged 92-page book recently published by Industrial Chemical Sales Division, West Virginia Pulp and Paper Co., 230 Park Ave., New York City. The subject is well organized in ten chapters, with ten authors contributing parts of these chapters. Many illustrations and tables and an index make this an attractive and useful publication.

"Rotax" electric-operated control as employed in pumping applications is described in bulletin B-294 now available from The Foxboro Company, Foxboro, Mass.

"Recommended Practices for Inspection of Fusion Welding" is a 23-page bulletin with a heavy paper cover, available at 40 cents per single copy, with discounts for quantities, from the American Welding Society, 33 West 39th St., New York. The report is the result of two years' work by the Society's Committee and covers: qualifications of welding inspectors; duties of inspectors; inspection and testing of welded structures; inspection during construction; shop and field inspections; examination of welds; radiographic inspection, hydrostatic testing and magnetic powder inspection. A considerable portion of the report deals with the welding characteristics of both ferrous and non-ferrous metals.

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in the American Water Works Association, and enclose herewith the sum of $....., one year's dues in advance.

Name.....

Company or Department.....

Title or Position.....

Address.....

.....

If application is for Junior Membership, give date of birth.....

If application is for Affiliate, state number of active services in property where employed.....

Nature of business or character of work (for office records).....

.....

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If application is for Corporate or Associate Membership, it must be signed by the person designated to represent the firm or corporation in A.W.W.A. activities.

.....
Signature of Applicant.

Application obtained by:

.....

(over)

ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, $10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

NEWS OF THE FIELD

Water Utility Report PD-193B and the Surplus Inventory

1. The larger water departments and companies in the United States have recently received Water Utility Report Forms PD-193B to complete for the second quarter of 1942. The Federal Power Commission has made the services of its statistical staff available to the Power Branch of the WPB in the interest of prompt summarization of the reports as they are filed.

2. While the departments required to file this report cover almost 50 per cent of the water-served population of the country, and while the other water departments have not yet been required to file such reports, no water department of any size is justified in disregarding the terms of Preference Rating Order P-46 as they affect the purchase, use and reserve stores of water works materials.

3. The second quarter report form (PD-193B) calls for a surplus inventory (in dollar terms) as of June 30. It is noted that fuel and chemicals are not to be reported in this surplus. Section f-v-6 of P-46 states that these items are not included in the "restricted" list of inventory items. All other items on the report form are to be extended in the surplus column if an excess exists in the department's inventory.

4. Some operators have overlooked the fact that their 1940 inventory is the base upon which they are required to operate. This inventory was filed by all the larger plants when they made their returns for the year 1941 on Form PD-193B. All plants are bound by the restrictions which appear in P-46 under f-2 as follows:

> "No Producer shall at any time accept deliveries of any item of Material to be used as Operating Supplies or for Maintenance or Repair or any other purpose until the Producer's inventory and stores of items of Material of the same class have been reduced to a practical working minimum. Such minimum shall in no case exceed the aggregate dollar volume of items of Material of the same class in inventory and stores on the most recent date during the calendar year 1940 on which the Producer's inventory was taken."

The "practical working minimum" or the "stores record on the most recent date during the calendar year 1940" is the base beyond which current inventory material is deemed to be surplus. For example, if a department's reserve stock of cast-iron pipe in 1940 had a dollar value of $10,000 and today has a dollar value of $12,000 the surplus of cast-iron pipe amounts to $2000. It must be so reported and made available to any authorized agency which can apply a rating of A-5 or better to the transaction.

(Continued on page 2)

(*Continued from page 1*)

5. It should just as clearly be understood that "raiding" water works minimum inventories is not authorized by the present orders. The simple fact that an agency having an A-5 or better rating wishes to draw upon material in a water works inventory is not in itself a mandatory right—except in so far as it may be shown that the material in question is surplus. The necessity of water works operators maintaining a reserve of maintenance and repair material is fully recognized and admitted by governmental agencies associated with the war effort. No one yet has been given authority to go into the stores yard of a water utility and take what he wants without reference to the needs of the utility.

6. On the other hand, there may be very good reasons of public policy to support the willingness of a water department to allow a proper agency having an adequate rating for its needs, to draw upon the stores of the utility, even below the recognized minimum needs of that utility. Such an attitude can be justified in the light of current conditions where critical military production plants are unable to obtain pipe, valves, etc. as soon as required, that are necessary to complete the project and get it into production. If they have a rating for their job which is extendible and can be applied by the water works man on his order to replace his minimum stores, they are entitled to consideration. The operation simply gives the military agencies available material immediately and the water works man waits his turn, with the rating conferred, to obtain the replacement to his inventory. (To simplify such transactions, the rating applied to valves, hydrants or any other "copper-bearing" item should be A-1-k or better.) It is assumed that under such circumstances, no water works executive would completely exhaust his stock of any reserve item nor would he fail to satisfy himself that he could depend upon his neighbors for assistance and materials if an emergency of magnitude had to be met.

7. Attempts are being made to justify increased inventories in the interest of Civilian Defense. No issue will have to be taken with the theory upon which that attitude is based. But a very practical fact must be faced. The War Production Board—not the Office of Civilian Defense—controls the flow of materials into the hands of water works men. If a water works man wishes to maintain an increased inventory over 1940 records to care for civilian defense or other needs in his opinion having

(*Continued on page 4*)

Samuel E. Killam, Director and Chief Engineer, Water Div., Boston Metropolitan District Com., died on June 18 while on an inspection trip in the course of his duties. Mr. Killam was a leader in the New England Water Work Assn. and had been an Active Member of the A.W.W.A. since 1915.



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CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

merit, he must make application to and receive authority from the War Production Board for this increase. For many months, this office has pointed out that advice to increase inventory or add to plant facilities had to be considered in the light of the fact that increase in inventory or plant had to be definitely authorized by the WPB. It is greatly to be regretted that national agencies interested in defense and protective measures, have not yet squarely faced these same facts at the executive level and assisted in developing a policy within the WPB that would make it practical for the water works man to carry out the advice he has received. Such administrative and inter-departmental problems can very properly be negotiated by Washington authorities and the national interest will gain by the discussion and decisions made.

8. Water works men have at this moment the problem of meeting a situation resulting in part from these conflicts in administrative attitudes. But they must be realistic and cooperate with the agency that holds the "purse-strings" of the materials they have to get in order to render service. In other (and very plain) words, this is not the time to argue that the inventory control policy of the WPB should be lightened. This is the time to accept the fact that it is tight—and in good spirit make any surplus available to agencies having an immediate and crying need for it. Water works men should now get together and find ways to make this surplus disposal program effective. If a Mutual Aid Plan is operating in a state, the water works men should fit the surplus disposal and mutual aid program

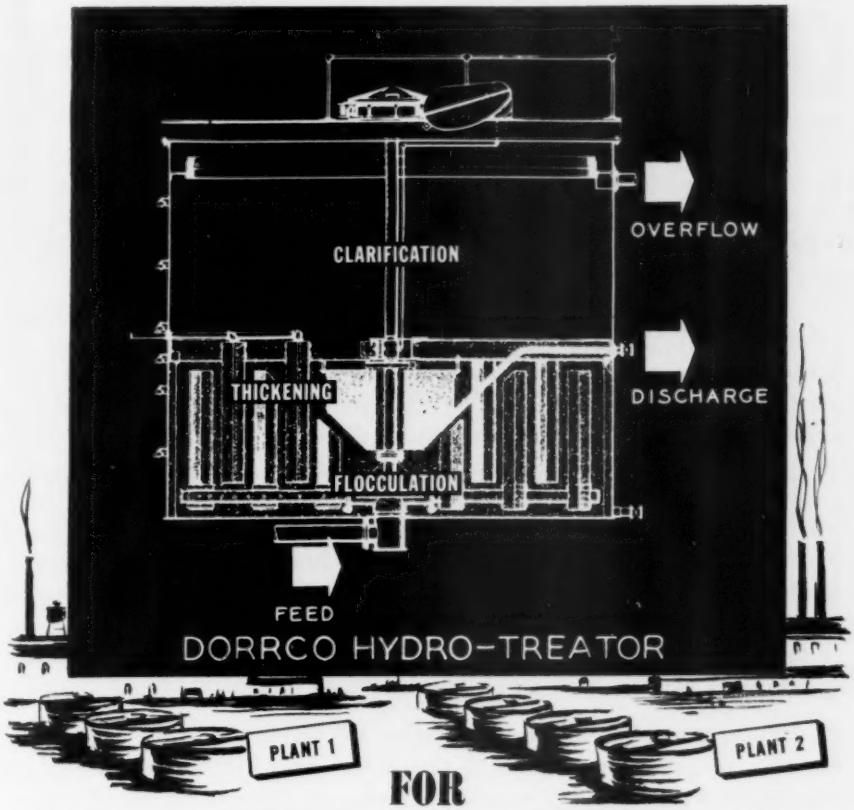
(*Continued on page 6*)

Emmett O. MacDonald, who retired two years ago, after a 54-year career in water works, died suddenly in Chicago on June 17. Mr. MacDonald started and concluded his career at the Sterling, Ill., utility. His initial work was on the installation of mains, first as laborer, then as a foreman. From 1926 to 1940 he was manager of the Northern Illinois Water Corp. in Sterling. The local water plant was acquired in 1926 from the Federal Water Service Corp. When Mr. MacDonald came to it, he built the new reservoir and made other improvements, including laying of a cast-iron supply main under a river to Rock Falls.

In the interim, Mr. MacDonald was associated with companies, as manager or in construction, at Geneva, Ill.; Burlington, Iowa; Menominee, Mich.; Racine, Wis.; Erie, Pa.; Wabash, Ind.; Warren, Ohio; Decatur and Montgomery, Ala.; Durham, N. C.; and Maynard, Mass.

Mr. MacDonald was 77 years old and had been an Active Member of the A.W.W.A. since 1904.

40 M.G.D. OF WATER SOFTENING



FOR HIGH EXPLOSIVE MANUFACTURE

★ Local well water won't do for the manufacture of this particular high explosive—too much iron, too much temporary hardness. Soft clear water, virtually iron-free is essential—not over 15 P.P.M. turbidity, not more than 85 P.P.M. total carbonate hardness.

Dorrco Hydro-Treators, 60 ft. in diameter by 18 feet deep proved to be the answer for the preparation of both process and condenser water. Four are now in operation and three more are on the way.

The Dorrco Hydro-Treator provides 3 separate zones for 3 separate and essential steps—Flocculation, Clarification, and Thickening.

Write for our leaflet on the Dorrco Hydro-Treator.

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ATLANTA TORONTO CHICAGO DENVER LOS ANGELES

(*Continued from page 4*)

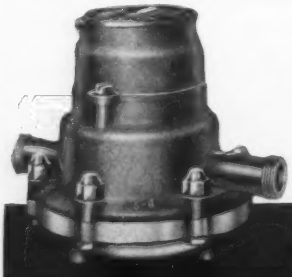
together. This may sound illogical at first but if you will remember that "national interest" is the only reasonable objective for any of us, you will see that mutual aid does not necessarily consist in grabbing all we can get and keeping it. Rather does it consist in seeing to it first—that every pound of pipe, valves, or hydrants in the hands of any water plant be put to work if it can be spared, and second—that every water department maintains its plant in good condition and its reserve material inventory at a safe minimum level. By and large, there is no need to set up two agencies to do what is actually a single job. If a mutual aid organization has been set up, it should have the help from the active water works field that will enable it to put surplus inventory into useful channels and at the same time maintain the proper working minimum for actual needs.

9. Every member of the Association has received a copy of the address given by J. A. Krug at the Chicago Conference. There should be no doubt in the minds of any man who has read the address that the military need for materials is critical and that water works men are obligated to adjust their ways of planning and doing things to the fact that an emergency exists. The press accounts of the cancellation of the Louisiana ship yard building contract so that 1942 steel would be available for ship building in yards already built should convince anyone that *surplus idle* metal in 1942 is not defense and does not help in the war effort. This memorandum therefore is intended to advocate complete co-operation in clearing water works inventories of surplus stock. Advice that plans for such co-operation are definitely under way is anticipated.—HARRY E. JORDAN, *Secretary, A.W.W.A.*

Water works projects were placed at the top of the list in a full agreement on the question of priority ratings on critical materials needed for war public works projects which has been concurred in by the War Production Board and the Federal Works Agency, Brigadier-General Philip B. Fleming, Federal Works Administrator, announced recently.

(*Continued on page 8*)

NIAGARA IRON CASE WATER METERS



provide wartime copper conservation plus the time-proved Niagara design. They comply with victory-meter limitations. Works are interchangeable with American Bronze Case Meters.

WRITE FOR CATALOG.

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.

YOU CAN USE LEAD

for service pipes and calking

No government order now prohibits you from using lead for water service pipe or for calking joints on mains. This is because lead is in sufficient supply so that all military requirements are being met promptly and enough lead remains for many civilian purposes, particularly for such essential industries as water distribution.

Water works which have used lead need not look for a substitute for this time-tested material; others can use lead to solve their critical material problems.



Lead pipe and calking lead stamped with the "Seal of Approval" meet the Standards of the Lead Industries Association which are currently identical in substance with those of the National Bureau of Standards. Insist on this Seal on the lead you buy for dependable quality.

If you are not receiving our helpful free magazine, LEAD, write for your copy and keep up with the latest developments in lead.

LEAD INDUSTRIES ASSOCIATION
420 LEXINGTON AVENUE, NEW YORK, N. Y.
YOU'RE MONEY AHEAD WHEN YOU WORK WITH LEAD

(*Continued from page 6*)

The agreement provides that both agencies will be mutually guided by certain criteria in the planning and construction of essential war public works and in the issuance of effective priority certificates and the allocation of necessary materials.

The Federal Works Agency agreed to submit no proposal to the War Productions Board for a priorities certificate or allocation of material for a war public works project unless:

(a) It is essential for the war effort.

(b) Postponement of construction would be detrimental to the war effort.

(c) It is not practical to rent or convert existing facilities for the purpose.

(d) The construction will not result in duplication or unnecessary expansion of existing plants or facilities now under construction or about to be constructed.

(e) All possible economies have been made in the project, resulting in the deletion of all non-essential items and parts.

(f) The project design is of the simplest type, just sufficient to meet the minimum requirements.

(g) Sufficient labor, public utilities, transportation, raw materials, equipment and the like are available to build and operate the plant, and the manufactured product can be used at once or stored until needed.

According to John M. Gallagher, regional director of the FWA for New England, New York, New Jersey and Pennsylvania, it was also agreed that before a project is submitted to the President for approval it will be clearly demonstrated that it has the approval of the Army, Navy, Maritime Commission, Lend-Lease Agency or the War Production Board.

Recommendations of these agencies will be supported by resolutions of Vital Area Boards or by recommendations from the local command of military reservation, posts, bases, shipyards or war production industries or from the National Housing Agency.

(*Continued on page 10*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

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TURN IN ALL YOUR SCRAP
It'll Shorten The War

Let's Face These Facts: It takes approximately a half-ton of scrap steel to make a ton of new steel—for ships, tanks, guns, and other vitally needed fighting equipment. Scrap steel speeds production, too. Waste materials—scrap metals, rubber and all the rest—are the life-blood of America's war industry. The demand is great, the supply dwindling. Before we can win, *every pound* of these idle materials must be converted into deadly fighting weapons.

You Can Help: How? By becoming scrap conscious. By making sure *all waste materials are put to work.* Check your junk piles. Inspect idle equipment. If it can be used—fine! If not, why not scrap it? (Scrap steel collected will be purchased by the steel industry at the government-controlled price.)

What To Do: Name a wide awake salvage committee chairman for each department and division in your organization. Set up a definite continuous salvage program. Separate the scrap—ferrous and non-ferrous metal, for example. Then whenever you have a sufficiently large quantity, call the scrap dealer. Also encourage your employees to collect their old rubber and discarded metal household equipment and get it to a local salvage committee, charity or junk dealer.

A Job for Everyone: Collecting scrap materials is vital to every American. Every pound turned in will help shorten the war. It's a job that every citizen, every company, and every industry with a stake in America's future must share in doing—today and every day for the duration. The American Rolling Mill Company, 2301 Curtis Street, Middletown, Ohio.

ARMCO

This advertisement is in support of the Salvage Program of the Bureau of Industrial Conservation, the War Production Board.

(*Continued from page 8*)

Besides providing that water supply projects be given special consideration, the agreement lists other utilities in the following order: power projects, fire-fighting equipment, sewerage, access roads and bridges. The order of hospitals, health centers, schools and recreational facilities will be determined in each area by the Federal Works Agency and the Federal Security Agency on the basis of war need in that area.

These requirements for priority ratings were agreed upon, Mr. Gallagher explained, in order to speed completion of the Federal Works Agency's $300,000,000 war public works program. In Region No. 1, comprising the nine Northeastern States, 195 projects have been approved for construction at an estimated cost of $32,980,824 of which $23,052,942 is in Federal grants and loans.

Personnel Changes in the WPB Power Branch

J. A. Krug, who has been Chief of the Power Branch of WPB, was made Deputy Director for Priorities Control in the WPB reorganization announced on July 28. Mr. Krug is well known to the water works field for his careful attention to the field's needs for maintenance and operation, concurrent with doing all possible to further the general war effort.

(*Continued on page 12*)

Arthur Gorman of Chicago heads the new activity of the Power Branch of the War Production Board as Chief of its Water Section. He will have a staff of professional and clerical assistants to work with him on matters assigned to the Section.

The scope of the work is outlined as follows:

Survey existing water supply facilities which may have become critical due to war operations.

Stimulate water conservation.

Review proposals for extension of water systems.

Maintain liaison with other WPB agencies insofar as water supply requirements are concerned.

Recommend policies and procedures for the WPB in allocation of present water supplies and in developing forms in order that the War Program be not handicapped by water shortages.

Co-operate with the other WPB Section, Branch and Division Chiefs, maintaining close relationship and uniformity in application of the Water Program particularly as it applies to the use of critical materials in developing additional water supply.

PROTECTED

... NOW AND FOR YEARS TO COME

To keep maintenance at a minimum, to protect the line against tuberculation, corrosion and electrolysis, and to maintain a high coefficient of flow, this pipe has been coated inside and out with Barrett Waterworks Enamel.

Made from the most stable bituminous material known for underground pipe protection, this lining resists water absorption and is completely non-conducting. It is low in cost and saves operating expense throughout the life of the pipe. It meets the American Water Works Association's standard specifications.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK

Barrett WATERWORKS ENAMEL



Greeley, Colo.—Thompson Pipe and Steel Co., Denver, Colo.—Barrett Enamel.

FIELD SERVICE—The Barrett Waterworks Service Department and staff of Field Service men stand ready to provide a broad measure of cooperation. These services include consultation on technical details, training of crew, and job inspection.

(*Continued from page 10*)

Mr. Krug in a speech at the A.W.W.A. Conference on Wartime Water Works Problems at Chicago appealed to all water works operators to reduce their materials requirements to a minimum to further the war effort now. He cited certain indications of water works unduly augmenting their inventories during the first part of 1942. Mr. Krug's speech, complete with questions and answers, was specially mailed to all A.W.W.A. members under date of July 15.

Herbert S. Marks, who has been Assistant General Counsel of WPB and Counsel of the Power Branch of WPB, succeeds to Mr. Krug's duties under an appointment as Acting Director. Mr. Marks is thoroughly acquainted with the operations of the Power Branch, having served as Counsel of the Power Branch since its creation in July 1941.

The promotions of Messrs. Krug and Marks were part of a reorganization announced at the same time as the announcement that the War Production Board would have final authority over all allocation of vital materials, with the Army and Navy Munitions Board serving as an "advocate" for the needs of the military program.

(*Continued on page 14*)

In JOINTING BELL and SPIGOT MAINS

Tegul-

MINERALEAD

Goes three times as far as lead
Weighs only one-fifth as much

Thiokol (synthetic rubber) combined with sulphur in *Tegul*-MINERALEAD reduces initial leakage to a negligible minimum • *Tegul*-MINERALEAD

- SAVES ON FREIGHT AND HANDLING COSTS
- CANNOT CHANGE ITS COMPOSITION
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- REQUIRES NO SKILLED LABOR, CAULKING OR DEEP BELL HOLES
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- IS AVAILABLE QUICKLY ALMOST EVERYWHERE

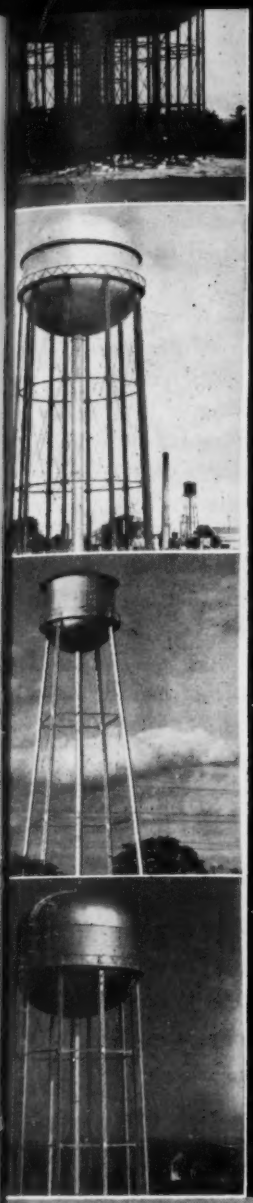
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The ATLAS MINERAL PRODUCTS Company
of Pennsylvania, Mertztown, Pa.

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VALVES
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M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.



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● In your water-storage planning for the *future*, use Pittsburgh-Des Moines' project counsel today! The skill and experience which have built P.DM Elevated Steel Tanks of every type for communities throughout America is at your service—without obligation.

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NEW YORK, ROOM 921, 270 BROADWAY · CHICAGO, 1228 FIRST NATIONAL BANK BUILDING

DALLAS, 1229 PRAETORIAN BUILDING · SAN FRANCISCO, 631 RIALTO BUILDING

SEATTLE, 1132 EIGHTH AVENUE, SOUTH

(*Continued from page 12*)

Wm. E. Stanley, who has been on leave of absence for the past year from his post as Professor of Sanitary Engineering at Cornell University, has been commissioned as Major in the U. S. Army Corps of Engineers. During the past year, Prof. Stanley first worked on specifications and contract documents for the Southern Indiana Cantonment Project before fulfilling for the past nine months the duties of Chief of the Sewerage and Incineration Group in the Office of the Quartermaster General, Washington, D.C. Prof. Stanley's service to the A.W.W.A. is exemplified by his chairmanship of the committee which produced the "Tentative Manual of Safe Practice in Water Distribution" published in the June JOURNAL.

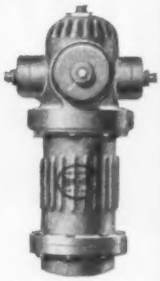
F. W. Kittrell, formerly Engineer-Secretary of the Interstate Commission on the Potomac River Basin, Washington, D.C., has gone to the Health and Safety Department of the T.V.A. at Wilson Dam, Ala.

Thomas F. Bowe, Consulting Engineer, New York, has been commissioned Lieutenant in the U.S. Coast Guard Reserve and is attached to the Port Captain's Staff, Barge Office, New York, N.Y.

(*Continued on page 16*)

VOGT FIRE HYDRANTS

Standard—
"Traffic Model"—
Flush Type—
Water Crane
Type



VOGT GATE VALVES



Non-Rising Stem—Outside Screw and Yoke—Hub End—Flanged End—Ends to Fit any Type Pipe.

Also—Floor Stands, Shear Gates — Tapping Sleeves and Valves, Flap Valves and Mud Valves.

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MAIN AT 14th ST.
LOUISVILLE, KENTUCKY

Use LAMOTTE EQUIPMENT for
pH Control—Residual Chlorine Control
Boiler Feed Water Control
Determination of sulfides in
sludges and gases

LAMOTTE CHEMICAL PRODUCTS CO.
"Originators of the practical application of pH Control"
Dept. AWA Towson, Baltimore, Md.

FILTER SAND

99 Per Cent Pure Silica
Washed, dried and manufactured to your specifications

Write for Prices on
Bulk, Carload or Bags

Dawes Silica Mining Co.
Thomasville, Georgia



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In the United States Navy, the highest of all honors is the Navy "E", the emblem of excellence awarded for supremacy in gunnery, communications and engineering.

Until recently the Navy "E" has been restricted to personnel of the United States Navy.

By special permission of Franklin D. Roosevelt, President of the United States, and Frank Knox, Secretary of the Navy, the Navy has awarded the Navy "E" to the De Laval Steam Turbine Company for outstanding excellence in industrial production.

The De Laval plant at Trenton, New Jersey, is now permitted to fly the All-Navy burgee, while each employee has received the special Navy "E" lapel insignia in evidence of a job "WELL DONE"

DE LAVAL STEAM TURBINE CO. TRENTON, N.J.

(*Continued from page 14*)

Charles C. Gouge, formerly Chief Operating Engineer, Water Supply, U.S. War Department Utilities, Camp Wallace, Tex., has enlisted in the Navy.

Edward P. Wagner, Civil and Sanitary Engineer of New York, is now a Lieutenant in the Civil Engineering Section of the U.S. Coast Guard in Washington, D.C.

Richard S. Green, formerly Sanitary Engineer with the Kitsap County Health Dept., Bremerton, Wash., has been serving with the U.S. Public Health Service in the defense area of the Puget Sound Navy Yard, and was transferred in June to the Division of Public Health Engineering, Territorial Department of Health, at Juneau, Alaska.

Hugh B. Rice, Civil Engineer of Lexington, Va., is now serving as Captain, Corps of Engineers, in Baltimore, Maryland.

R. C. Stockman, formerly Assistant Engineer to the City Engineer of San Diego, Calif., is now a First Lieutenant at Camp Roberts, Calif.

(*Continued on page 18*)

EDSON
DIAPHRAGM PUMPS

Hand Operated--sizes 2", 2½", 3", 4"
Power Operated--sizes 3" and 4"

Open Discharge or Force Pump
Skid, Truck or Trailer Mounted

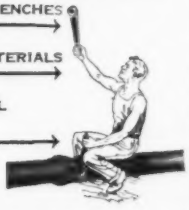
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Brass Couplings - Bronze Clamps
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Also—Brass Hydrant Pumps

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3 *Money, Time and Labor Saving Features of*
UNIVERSAL
CAST IRON PIPE

LAID WITH ONLY WRENCHES
NO CAULKING MATERIALS
NO GASKETS. NO BELL HOLES TO DIG.



For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

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THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

NAME _____
STREET _____
CITY _____

..... How much do YOU pay for repairs to broken hydrants?

$50

$10

When ordinary designs of fire hydrants are broken by an automobile out of control or a heavy truck, the entire standpipe must be replaced, requiring a lengthy and costly repair job.

On the other hand, the Kennedy SAFETOP, while fully as strong and as resistant to ordinary impacts as a one-piece hydrant, limits breakage from smashing impacts to inexpensive, easily replaceable parts.

No water is lost; and the entire repair job can be done by one man, within half an hour, without excavating, and at a total cost of less than $10.00 for repair parts and labor.

Many thousands of Kennedy SAFETOPS are in service; and the water department superintendents responsible for them are enthusiastic about their dependability, easy operation, and low maintenance cost.



The Kennedy Valve Mfg. Co., Elmira, N. Y.

KENNEDY
SAFETOP FIRE HYDRANT
REG. U.S. PAT. OFF.

(*Continued from page 16*)

John B. Ogden, former Manager of the New Jersey Water Service Company, Little Falls, N.J., is now Assistant Engineer at the Passaic Valley Water Commission, Paterson, N.J.

F. C. Dugan, former Director of the Bureau of Sanitary Engineering, Kentucky State Department of Health, Louisville, is now on active duty, serving as Major in the Corps of Engineers, U. S. Army. He is stationed at Fort Knox, Kentucky. R. R. Harris was appointed Acting Director to succeed Major Dugan on June 29.

Edward E. Wolfe has resigned as City Chemist and Superintendent of Water Purification, Hannibal, Mo., a position which he filled for the past eighteen years, and is now Assistant Power Engineer in charge of Water Supply at the Atlas Powder Company's Weldon Spring Ordnance Works, Weldon Spring, Mo.

The Annual Convention of the New England Water Works Association, previously scheduled for Poland Spring, Me., has been cancelled and in its place, an Annual Meeting will be held at the Hotel Statler, Boston, on Tuesday and Wednesday, September 15 and 16. This change is made at the request of the administration for the curtailment of travel, and in accordance with the wishes of the majority of the membership of the Association, as voiced in a recent poll on the question.

Business of the Association will be transacted and technical sessions will be devoted to wartime water works problems. An informal dinner will be held Tuesday evening, September 15.

There are at present no government orders of any kind prohibiting the use of lead for water service pipe and calking, whether it be to supply war housing, war factories or other kinds of construction. Lead is in sufficient supply to take care of all military requirements as well as essential civilian needs.

As water distribution is classed as an essential civilian need, the War Production Board, Army and Navy all permit the use of lead for this purpose. The following letter from the Lead Branch of the War Production Board illustrates this point:

"Supplies of lead at present are such that all military requirements are being promptly met and enough lead remains for essential civilian use. Since water distribution is essential there seems to be no reason why lead water service pipe and calking lead should not be used. In fact, conservation measures which have been taken in lead have been with the intent of making enough lead available for military and such essential civilian purposes. It seems that lead, therefore, should be employed, particularly for

(*Continued on page 20*)



WORTHINGTON

EQUIPMENT FOR WATER SUPPLY

CENTRIFUGAL PUMPS	STEAM AND POWER PUMPS
TURBINE WELL PUMPS	SUMP AND DRAINAGE PUMPS
DIESEL ENGINES	GAS ENGINES
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WATER PURIFICATION EQUIPMENT
Water Softeners Pressure Filters

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WATER METERS

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

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(*Continued from page 18*)

water works extensions to war housing projects and other construction connected with the war effort.

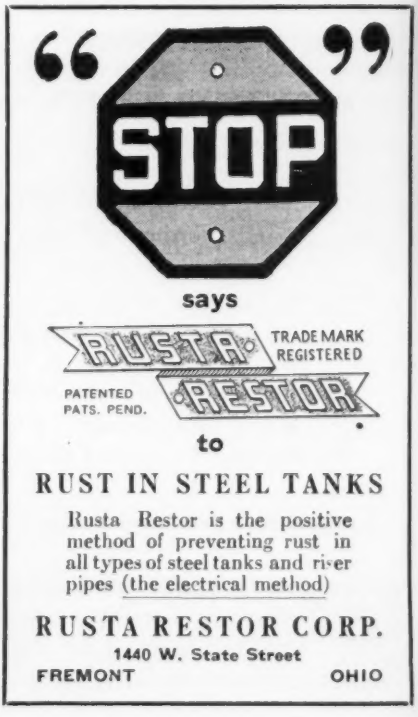
"I would like to remind you, however, of the fact that while lead at the present time is in ample supply any unforeseen militar yor naval occurrences or demands not at present anticipated might change the entire picture."

The solder shortage, resulting from our loss of Far Eastern tin producing areas, need not interfere with the use of lead water services. Although wiping solder is still available to water utilities, it is desirable to conserve it as much as possible. Joints may be made by lead welding instead of soldering where practical. Such joints, properly made, have been tested without failure beyond the bursting point of the pipes they connect. There are already many mechanics able to make this type of joint, and numerous classes have been started to instruct others in the art, which can be learned quickly by capable mechanics.

A chart for quickly determining the drop in pressure accompanying the flow of air or gas through pipes of known diameter and length is being distributed by the De Laval Steam Turbine Co., Trenton, N.J. For a

(*Continued on page 22*)





A BRIGHTER FUTURE FOR YOUR CITY

—in soft, clear, iron-free water



HAPPIER HOMES!

Soft, clear water means less work, more fun



BUSIER INDUSTRIES!

Less treatment for boiler and process water

MORE PROSPEROUS SHOPS!

Better Service—at less cost—for laundries, restaurants, etc.



Plan now for a better water supply

After the war, when public improvements are resumed, a good water supply will be the first thought of many communities. Take the first step toward this modern necessity *now*. Write for free booklet to The Permutit Company, Dept. G-2, 330 West 42nd Street, New York, N. Y.

In Canada: Permutit Company of Canada, Ltd. Montreal . . . Toronto . . . Winnipeg . . . Calgary

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Permutit* Spaulding Precipitator

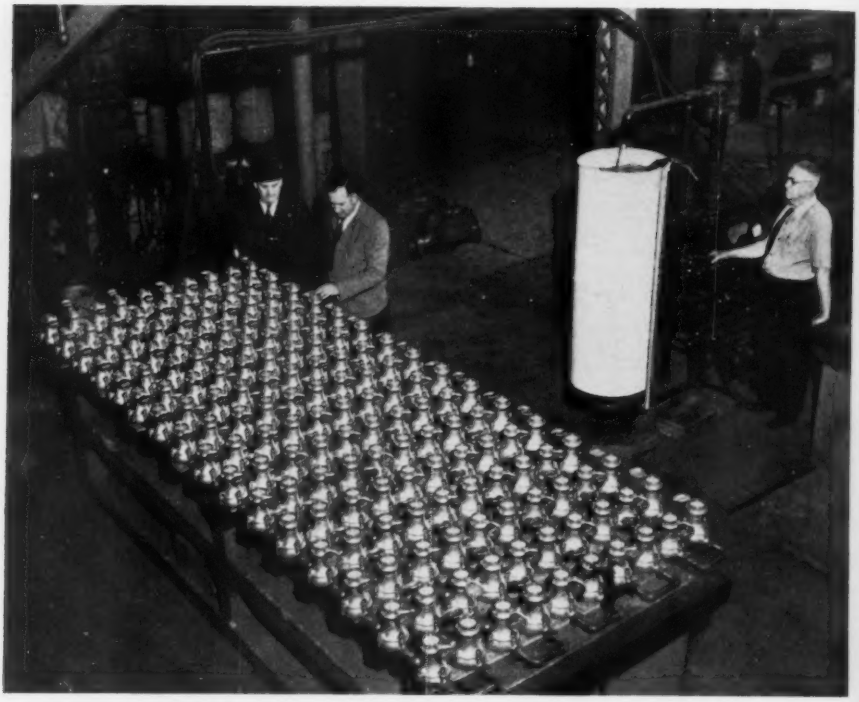
Here's a new type of equipment that puts soft water within reach of every community. It makes cold lime soda treatment more practical than ever before, because it takes only half the space of old-type plants, cuts precipitation time, makes big savings in chemicals.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

(*Continued from page 20*)

given rate of flow through a pipe of given diameter, the chart gives a friction factor, from which the pressure drop is readily calculated by simple multiplication and division, taking into account the temperature, the specific gravity, and the pressure. An auxiliary alignment chart provides for reducing pipes of different diameters to equivalent lengths of a single diameter in order to simplify the calculation for systems containing piping of various diameters.



Shown above is the Los Angeles Department of Water and Power arrangement for mass production scale meter testing. Inspecting the meters are E. H. Thacker and George Sopp, with Guy Strope filling the 10-gal. test tank. By this arrangement, a bank of 160 meters of either $\frac{5}{8}$- x $\frac{3}{4}$-in. or $\frac{3}{4}$- x 1-in. sizes may be tested at one time whereas previously only ten could be tested at one time.

A new catalog on "Asarco Type K Tube-Loy and Grinnell Superseal Flared Tube-Loy Fittings" has been released by the American Smelting and Refining Co., Lead Products Div., 120 Broadway, New York. The catalog contains much information on the products, their use, cost, performance and installation procedure.

(*Continued on page 34*)

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(*Continued from page 26*)

Johnson, John D., Gen. Supt., Bureau of Water, 701 French St., Erie, Pa. (July '42)

Johnstone, A. J., Asst. Supt., Illinois Water Service Co., 122 N. Walnut St., Champaign, Ill. (July '42)

Jones, Alton W., Water & Sewage Plant Operator, U.S. Dept. of Agriculture, Farm Security Administration, Canal Point, Fla. (July '42)

Jones, Roy G., Supt., Tract No. 349, Mutual Water Co., Cudahy, Calif. (July '42)

Kaiser, Clarence T., Supt. of Filtration, Water Works Dept., Box 301, Newark, Ohio (July '42)

Kauffman, James B., Assoc. Engr., Bureau of Water Supply, 1307 W. Baltimore St., Baltimore, Md. (July '42)

Kimberley, Harvey D., Supt., Water Works Dept., Warsaw, Ill. (July '42)

Kingston, S. P., Public Health Engr., Minnesota Dept. of Health, 212 City Hall, Rochester, Minn. (July '42)

Konsack, Walter W., Supt. of Water, Flossmoor, Ill. (July '42)

Lightfoot, H. C., *see* Payette Water Dept.

Lippert, Paul, Engr. of Pumping Station Efficiency, 7148 E. End Ave., Chicago, Ill. (July '42)

Mallstrom, Roe E., Supt. of Water, 100 E. 154th St., Harvey, Ill. (July '42)

Margolis, Elly T., Technical Director, The Seven Up Co., 1221 Locust St., St. Louis, Mo. (July '42)

Marsh, Frederick E., Chemist, Council Bluffs Water Works, 520 Oakland Ave., Council Bluffs, Iowa (July '42)

Mason, William Caton, Filtration Engr., Div. of Water Purification, 1623 W. Leland Ave., Chicago, Ill. (July '42)

Maynard, Stuart B., Asst. Engr.—Filter Design, Bureau of Water, 241 Chestnut St. Pier, Philadelphia, Pa. (July '42)

McCaslin, Walter R., Cons. Engr., McCaslin & Co., Nokomis, Ill. (July '42)

McKee, James, Asst. Supt., Palisades del Rey Water Co., 427 Moscow St., Playa del Rey, Calif. (July '42)

Meara, John W., Comr. of Public Works, 16 James St., Middletown, N.Y. (July '42)

Meyer, Herman, Assoc. Public Health Engr., U.S. Public Health Service, c/o State Board of Health, Jacksonville, Fla. (July '42)

Mobile Water Works Dept., E. M. Stickney, Supt., City Hall, Mobile, Ala. (Corp. M. Apr. '42)

Moore, H. E., Sales Engr., Macco Construction Co., 815 Paramount Blvd., Clearwater, Calif. (July '42)

Mrva, Andrew E., Jr. San. Engr., Div. of Water Purification, 10220 S. Forest Ave., Chicago, Ill. (July '42)

Newnan Water & Light Com., Roswell C. Atkinson, Secy., Municipal Bldg., Newnan, Ga. (Corp. M. July '42)

Payette Water Dept., H. C. Lightfoot, Supt., Payette, Idaho (Corp. M. July '42)

Peoria Heights Water Works, Wilson Whittier, Chairman, 140 Kingman Ave., Peoria Heights, Ill. (Corp. M. Apr. '42)

Peterson, A., *see* Chillicothe Munic. Utilities

Ranney Water Collector Corp. of New York, Eugene W. Silitch, Mng. Director, 1510 Heyburn Bldg., Louisville, Ky. (Assoc. M. July '42)

Reiman, Walter A., Chief, San. Engr., State Board of Health, State Capitol Bldg., Little Rock, Ark. (July '42)

Ryan, Daniel M., Supt., Water Dept., City Hall, Brockton, Mass. (July '42)

San Bernardino County Flood Control Dist., R. V. Ward, Asst. Engr., 364 Mountain View Ave., San Bernardino, Calif. (Corp. M. July '42)

San Dimas-Charter Oak Domestic Water Co., J. R. Shoemaker, Mgr., San Dimas, Calif. (Corp. M. July '42)

Scott-Smith, Herbert, Supt. of Public Works, 114 Benedict St., Waterbury, Conn. (July '42)

Shoemaker, J. R., *see* San Dimas-Charter Oak Domestic Water Co.

Silitch, Eugene W., *see* Ranney Water Collector Corp. of New York

Slazas, Tony, Supt., Westville Water System, 318 W. Main St., Westville, Ill. (July '42)

Steffen, Alfred J., 1st Lt., Repairs & Utilities Sec., Div. Engr. Office, U.S. Army, 332 S. Michigan Ave., Chicago, Ill. (July '42)★

Steitz, Edward J., Supt., Water Dept., 16 James St., Middletown, N.Y. (July '42)

Stickney, E. M., *see* Mobile Water Works Dept.

Swanson, Elmer A., *see* Brookfield-North Riverside Water Com.

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† Director of Laboratories, Dept. of Water Supply, Gas and Electricity, N. Y. C.

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(*Continued from page 29*)

Tank, Earl, Supt., Water Dept., Almont, Mich. (July '42)

Trowbridge, A. C., *see* Iowa Geological Survey

Turner, Joseph Philip, Jr., Chief Chemist, Florida Public Service Co., 100 E. Central St., Orlando, Fla. (July '42)

Walker, Vernon L., Sr. San. Engr., Dept. of Public Health, State Health Dept., Springfield, Ill. (July '42)

Ward, R. V., *see* San Bernardino County Flood Control Dist.

Whittier, Wilson, *see* Peoria Heights Water Works

Yost, Harold W., Cons. Engr., Yost Engineering Co., 112 N. Central Ave., Phoenix, Ariz. (July '42)

Young, Francis D., Asst. Mgr., Pipe Sec., Cleveland Dist., Johns-Manville Sales Corp., 1530 Guildhall Bldg., Cleveland, Ohio (July '42)

Young, R. W., Chief Engr., Water Dept., 3647 Ave. C., Council Bluffs, Iowa (July '42)

REINSTATEMENTS

Burns, Ross, Sales Repr., Pittsburgh Equitable Meter Co., 1455 W. Congress St., Chicago, Ill. (Oct. '38)

Compton, Harold E. T., Chief Eng., United Filters & Eng., Ltd., "Pertenhall," Mayfield Ave., Orpington, Kent, England (Jan. '39)

Doland, James J., Prof. of Civ. Eng., Univ. of Illinois, 317 Engineering Hall, Urbana, Ill. (Nov. '29)

Fink, G. J., Supervisor of Lime Research, U.S. Gypsum Co., 1253 Diversey Parkway, Chicago, Ill. (Apr. '24)

Graves, Roy C., Foreman, Water Works, Anheuser-Busch, Inc., 721 Pestolozzi St., St. Louis, Mo. (July '35)

Middleton, W. G., Supt., Munic. Public Service Com., Yazoo City, Miss. (Apr. '29)

LOSSES

Resignations

Hanks, C. W., Supt., Water Works Constr., 1720 California St., Denver, Colo. (Aug. '33)

McDonald, F. L., State San. Engr., State Health Dept., State Capitol, Little Rock, Ark. (July '39)

Parry, Jack H., Sales Mgr., R. H. Baker Co., Inc., 2070 E. Slausson Ave., Huntington Park, Calif. (Oct. '41)

Passolt, A. A., Supt., Newnan Water & Light Com., Newnan, Ga. (May '25)

Patterson, W. E., Chief Chemist, Sternson Labs., Ltd., Brantford, Ont., Can. (Jan. '36)

Deaths

Hagins, C. E., Asst. to Gen. Mgr., Water Dept., 805 Franklin St., Johnstown, Pa. (Sept. '26)

Lofton, H. M., Gen. Mgr. & Treas., Columbian Iron Works, Chattanooga, Tenn. (May '95) *Honorary M. '40.*

MacDonald, Emmett, Mgr., Illinois Water Service Co., Sterling, Ill. (June '04)

Changes in Address

Changes of address between June 15 and July 15, 1942

Adams, John W., Supt., Carlinville Water Works System, 902 University Ave., Carlinville, Ill. (Apr. '42)

Berk, Ralph G., Ewing, Ind. (July '41)

Brannock, D. York, Chem. Engr., Sewage Disposal Plant, Rocky Mount, N.C. (Oct. '39)

Bristol, H. C., 401 Ramsey St., Alcoa, Tenn. (July '35)

Caldwell, David H., 1907 Gouldin Rd., Oakland, Calif. (Jr. M. Jan. '41)

Childs, Fred S., 2 Lafayette St., New York, N.Y. (May '30)

Dahljelm, Irving L., Supt., Filtration Plant, 103 North Ave., Highland Park, Mich. (Jan. '38)

Davis, Daniel E., The Chester Engrs., 210 East Parkway, N.S., Pittsburgh, Pa. (May '30)

Ford, John L., Secy.-Treas., Ford Meter Box Co., Wabash, Ind. (Jan. '36)

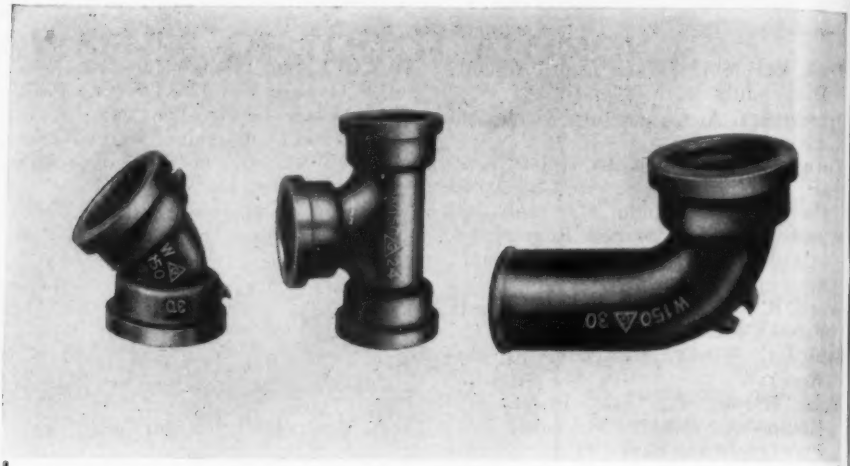
Ford Meter Box Co., John L. Ford, Secy.-Treas., Wabash, Ind. (Assoc. M. May '08)

Green, Richard S., Div. of Public Health Eng., Territorial Dept. of Health, Juneau, Alaska (Jan. '42)

Hall, John W., Mgr., Western Pipe & Steel Co., 2421 California Ave., Box 1066, Fresno, Calif. (July '41)

Helland, H. R. F., Cons. Engr., 130 W. Rosewood, San Antonio, Tex. (Jan. '35)

(*Continued on page 33*)



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(*Continued from page 31*)

Higgins, Roger C., Chemist, Board of Public Works, City Hall, Hannibal, Mo. (Jan. '37)

Hommon, Harry R., Sr. San. Engr. in Charge, U.S. Public Health Service, 1223 Flood Bldg., San Francisco, Calif. (July '21)

Kelso, Gilbert L., 707 Bauer Ave., Charleston, W.Va. (May '30)

Kittrell, F. W., Health & Safety Dept., Tennessee Valley Authority, Wilson Dam, Ala. (July '35)

Knox, W. H., 130 Webster Park Ave., Columbus, Ohio (Jan. '27)

Laughlin, Henry F., Chief Chemist, Industrial Chemical Sales Div., 1005 Jefferson Ave., Tyrone, Pa. (Jan. '36)

Lutz, Howland C., U.S. Public Health Service, 1307 Pere Marquette Bldg., New Orleans, La. (July '39)

McGuire, Orla E., Designing Engr., 515 Nachusa Ave., Dixon, Ill. (Jan. '39)

McQuilkin, Frank R., 16 Steiner Ave., Neptune City, N.J. (Jan. '42)

Ogden, John B., Asst. Engr., Passaic Valley Water Com., 137 Ellison St., Paterson, N.J. (July '38)

Pirnie, Malcolm, Jr., ℅Warwick County Health Dept., Hilton Village, Va. (Oct. '39)

Poulter, A. F., 1698 Lincoln Ave., San Jose, Calif. (Jan. '37)

Quimby, Frank K., 2135 Ridge Ave., Evanston, Ill. (July '30)

Raab, Frank, Sr. Chemist & Bacteriologist, Fridley Softening Plant, Minneapolis, Minn. (Oct. '21)

Rice, Cyrus Wm., Pres., Cyrus Wm. Rice Co., Inc., 17 Noble Ave., Pittsburgh 5, Pa. (Oct. '24)

Sawyer, Clair N., 2009 University Ave., Madison, Wis. (Jan. '41)

Schaefer, Walter A., San. Engr., 38 Prince St., Elizabeth, N.J. (Jan. '37)

Smith, Gilbert L., Sales Mgr., Johns Manville Sales Corp., 297 S. Broadway, Providence, Ky. (Oct. '41)

Sowden, Howard J., Engr. in Charge of Softening Plant, Federal Cartridge Corp., Bldg. 1006, New Brighton, Minn., (Jan. '39)

Spellman, W. A., Staynor, Ont., Can. (Jan. '40)

Stevenson, Albert Henry, Asst. San. Engr. (R), U.S. Public Health Service, Sub-Treasury Bldg., Pine & Wall Sts., New York, N.Y. (Jan. '40)

Tetzlaff, Frank, 4606 Walsh St., Chevy Chase, Md. (Jan. '36)

Van Reenen, W. J., Box 4519, Jacksonville, Fla. (Jan. '39)

Wolfe, Edward E., 1011 Circle Drive, St. Charles, Mo. (Apr. '22)

Wolff, William R., 680 Pelham Rd., New Rochelle, N.Y. (Mar. '30)

MEMBERS ENTERING MILITARY SERVICE

Bowe, Thomas F., Cons. Engr., 110 William St., New York, N.Y. (Feb. '20)★

Knox, W. H., 130 Webster Park Ave., Columbus, Ohio (Jan. '27)★

Lund, Armon, Asst. Chemist, City Water Dept., Lincoln St. & Sheridan Rd., Evanston, Ill. (Jan. '41)★

Siegmund, Rudolph A. 558 Adam St., Tonawanda, N.Y. (Apr. '39)★

Stockman, R. C., Asst. Engr., ℅ City Engr., San Diego, Calif. (Apr. '40)★

Wagner, Edward P., Civ. & San. Engr., 55 W. 42nd St., New York, N.Y. (Jan. '37)★

Wirth, Harvey E., Asst. San. Engr., Bureau of San. Eng., State Board of Health, State Office Bldg., Madison, Wis. (Jan. '41)★

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(*Continued from page 22*)

"The Search for Unity," a report by Raymond B. Fosdick, President, Rockefeller Foundation, New York, N.Y.:—

"If we are to have a durable peace after the war, if out of the wreckage of the present a new kind of cooperative life is to be built on a global scale, the part that science and advancing knowledge will play must not be overlooked. For although wars and economic rivalries may for longer or shorter periods isolate nations and split them up into separate units, the process is never complete because the intellectual life of the world, as far as science and learning are concerned, is definitely internationalized, and whether we wish it or not an indelible pattern of unity has been woven into the society of mankind.

"There is not an area of activity in which this cannot be illustrated. An American soldier wounded on a battlefield in the Far East owes his life to the Japanese scientist, Kitasato, who isolated the bacillus of tetanus. A Russian soldier saved by a blood transfusion is indebted to Landsteiner, an Austrian. A German soldier is shielded from typhoid fever with the help of a Russian, Metchnikoff. A Dutch marine in the East Indies is protected from malaria because of the experiments of an Italian, Grassi; while a British aviator in North Africa escapes death from surgical infection because a Frenchman, Pasteur, and a German, Koch, elaborated a new technique.

"In peace as in war we are all of us the beneficiaries of contributions to knowledge made by every nation in the world. Our children are guarded from diphtheria by what a Japanese and a German did; they are protected from smallpox by an Englishman's work; they are saved from rabies because of a Frenchman; they are cured of pellagra through the researches of an Austrian. From birth to death they are surrounded by an invisible host—the spirits of men who never thought in terms of flags or boundary lines and who never served a lesser loyalty than the welfare of mankind. The best that every individual or group has produced anywhere in the world has always been available to serve the race of men, regardless of nation or color.

"What is true of the medical sciences is true of the other sciences. Whether it is mathematics or chemistry, whether it is bridges or automobiles or a new device for making cotton cloth or a cyclotron for studying atomic structures, ideas cannot be hedged in behind geographical barriers. Thought cannot be nationalized. The fundamental unity of civilization is the unity of its intellectual life.

"There is a real sense, therefore, in which the things that divide us are trivial as compared with the things that unite us. The foundations of a cooperative world have already been laid. It is not as if we were starting from the beginning. For at least three hundred years the process has been at work, until today the cornerstones of society are the common interests that relate to the welfare of all men everywhere.

(*Continued on page 36*)

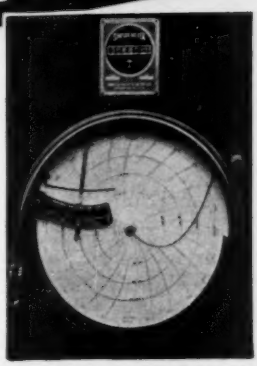
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(*Continued from page 34*)

"In brief, the age of distinct human societies, indifferent to the fate of one another, has passed forever; and the great task that will confront us after the war is to develop for the community of nations new areas and techniques of cooperative action which will fit the facts of our twentieth century interdependence. We need rallying points of unity, centers around which men of differing cultures and faiths can combine, defined fields of need or goals of effort in which by pooling its brains and resources the human race can add to its own well-being. Only as we begin to build, brick by brick, in these areas of common interest where cooperation is possible and the results are of benefit to all, can we erect the ultimate structure of a united society.

"A score of inviting areas for this kind of cooperation deserve exploration. Means must be found by which the potential abundance of the world can be translated into a more equitable standard of living. Minimum standards of food, clothing, and shelter should be established. The new science of nutrition, slowly coming to maturity, should be expanded on a world-wide scale. The science of agriculture needs development, not only in our own climate but particularly in the tropic and subtropic zones. With all their brilliant achievements the medical sciences are in

(*Continued on page 38*)

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HERSEY

(*Continued from page 36*)

their infancy. Public health stands at the threshold of new possibilities. Physics and chemistry have scarcely started their contributions to the happiness and comfort of human living. Economics and political science are only now beginning to tell us in more confident tones how to make this world a home to live in instead of a place to fight and freeze and starve in.

"All these matters await the future peace. Nevertheless they constitute the stern realities of the present, for as Vice-President Wallace has said: 'From the practical standpoint of putting first things first, at a time when there are not enough hours in a day and every minute counts, planning for the future peace must of necessity be a part of our all-out war program.' "

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The "Ironside" is fitted with a molded glass register box, which is a single piece, strong molded glass unit which is fitted snugly over the register and held by two screws against a fiber gasket. The inner mechanism is the same as that long successfully employed by the company in its Arctic and Tropic model meters. The "Ironside" meter is made in sizes from $\frac{5}{8}$ x $\frac{3}{4}$ in. up to and including 2 in. Copies of a bulletin describing the meter are available from branch offices of the company or from the company at 400 North Lexington Ave., Pittsburgh.

"Corrective Chemical Feeding" is a new 12-page bulletin recently released by the American Water Softener Co., Lehigh and Fourth Ave., Philadelphia. Technical data and specifications for the applications of various types of equipment make up the bulletin. An "Information Sheet" is provided to facilitate the requesting of recommendations and quotations.

(*Continued on page 40*)

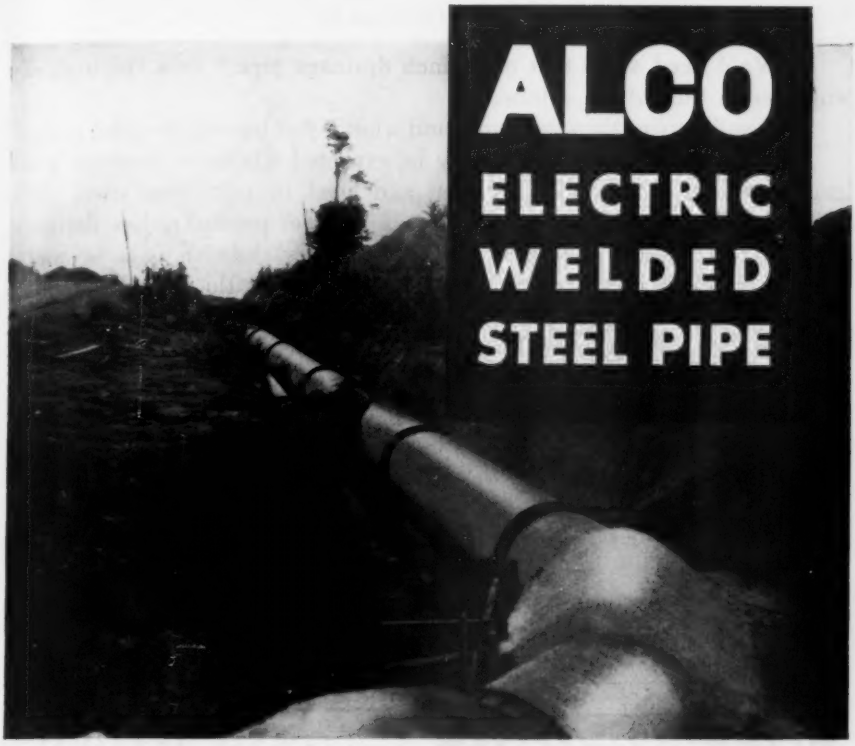
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(*Continued from page 38*)

"We'll need 4,000 feet of 24-inch drainage pipe," says the highway engineer to the culvert salesman.

"Fine!" replies the salesman, "and what'll you have it in—pine or fir?"

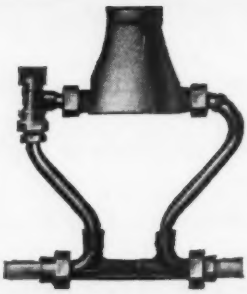
Such "peculiar" talk now may be expected wherever drainage work cannot wait for the return of iron and steel to peacetime uses. The American Rolling Mill Company, a major steel producer, has designed an all-wood culvert that does not require steel bands, nails or metal reinforcing of any kind. It goes "all out" to meet the War Production Board's demand for eliminating critical materials in all non-military projects.

Company officials explain that where engineering integrity demands it, corrugated metal drainage pipe may yet be used on vital war projects. But substitutes are urgently needed elsewhere because iron and steel must be conserved for war use.

The new ARMCO Emergency Pipe, unlike the ordinary box-like structure, is made up of a series of short, stout wood segments in a design that utilizes the full strength of the material. The units are shop-fabricated and assembled in lengths of 12 ft. or longer, and these in turn are

(*Continued on page 42*)

The Coppersetter
A COMPLETE METER MOUNTING



The COPPERSETTER is a simple, convenient and durable fitting for installing water meters in horizontal service lines. It is all brass and copper, made in several heights and can be provided with an inverted ground-key angle valve at the meter inlet. Write for more information about the COPPERSETTER.

The Ford Meter Box Co.
WABASH, INDIANA

STOP RUST
with
RUSTOP



Cathodic Protection ends rust
•
Cleans old tanks
•
Keeps new tanks clean
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No paint—No taste
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Write for estimate

ELECTRO RUST-PROOFING Company
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SKILFUL



40% of our Factory Employees have an average continuous service record of 32 years.

74 years experience in the water works field your guarantee of complete satisfaction.

IRON REMOVAL	DOUBLE SUCTION
SOFTENING	TWO STAGE
RAPID MIX	DEEP WELL TURBINE
FLOCCULATION	MIXED FLOW
RE-CARBONIZATION	AXIAL FLOW

Buy American

AMERICAN

THE AMERICAN WELL WORKS

AURORA ILLINOIS

MANUFACTURERS OF

Pumping,—Sewage Treatment,—and Water Purification Equipment

(*Continued from page 40*)

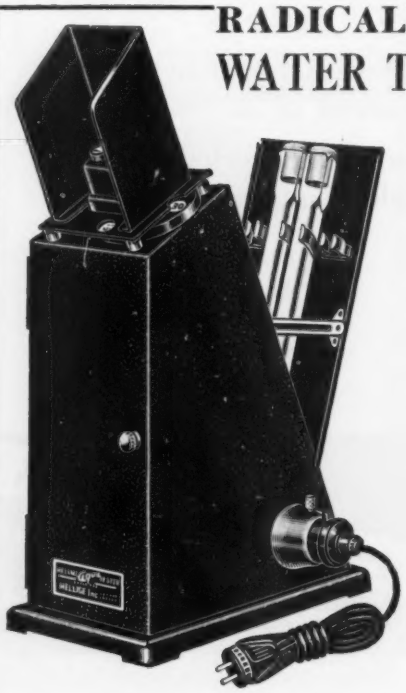
joined together at the job site. Tests have proved that the pipe is strong, reasonably flexible and—thanks to special treatment of the wood—sufficiently durable to outlast a five- or ten-year war.

"Transite Pipe . . . Repair of War Damage" is a 92-page book (DS Series 350) issued by Johns-Manville, 22 East 40th St., New York, N.Y. It contains a great number of photographs and diagrams with pertinent text giving practical and technical information. A comprehensive 2-page index makes the book readily useful as a reference.

The U.S. Department of Commerce has published a 320-page volume, "Trade and Professional Associations of the United States," which lists 3,000 larger co-operative organizations. It is edited by C. J. Judkins, Chief of the Trade Association Section of the Commerce Department, and classifies into industrial and geographical groupings, as well as enumerating census data on the relative size of all major industries in the United States. Many national associations have been of great assistance to the Federal Government in such matters as speeding up the production of war materials, perfecting standardization economics, and aiding in technical research

(*Continued on page 44*)

RADICALLY IMPROVED
WATER TEST COMPARATOR

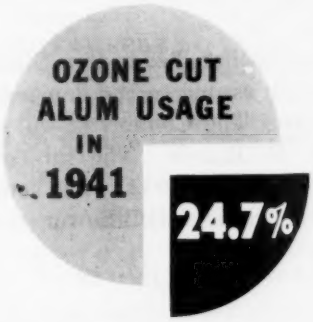


The new Hellige Aqua Tester combines the thoroughly demonstrated advantages of Hellige *non-fading glass color standards* with radical improvements in design. This new model is, we believe, the most advanced type ever brought on the market and demands special consideration as it brings to its user the utmost in permanent reliability, accuracy, convenience and, last but not least, economy. Standards for all popular A. P. H. A. and A. W. W. A. Methods and Hydrogen Ion Control are available.

Write for Bulletin No. 602.

HELLIGE
INCORPORATED
3718 NORTHERN BLVD. LONG ISLAND CITY, N.Y.

Ozone IMPROVES FLOCCULATION AT WHITING, INDIANA



This result is a matter of record at Whiting, Indiana, where the first major modern ozonation water purification plant in the United States was put into operation July, 1940.

It is noteworthy that during this same period, operators of other plants along the southern shore of Lake Michigan, using the same general source of supply, reported increased dosages of alum were needed to produce satisfactory flocculation.

By applying ozone to the incoming raw water, the organic matter (which inhibits flocculation) is oxidized, making satisfactory flocculation possible with a reduced alum dosage.

It is chemical savings like these that make the net operating cost for ozonation only $1.41 at Whiting.



Send for your copy of our supplement to Bulletin No. 104, which tells the up-to-the-minute story of ozone's success of Whiting.

OZONE PROCESSES

INCORPORATED

1500 WALNUT STREET, PHILADELPHIA

A WHOLLY OWNED SUBSIDIARY OF WELSBACH ENGINEERING AND MANAGEMENT CORPORATION

(Continued from page 42)

for substitute products and factory conversion to war needs. The A.W.W.A. has been one of these co-operating organizations.

The Directory may be obtained from the Government Printing Office at 70 cents per copy.

"Economics of Water Meter Testing and Repairing" is a 14-page booklet just issued by the Neptune Meter Company. It discusses leakage and the effectiveness of meter testing. Costs, repairs, and the exigencies of war are discussed, and a good many statistics cited. The booklet is available upon request to the Neptune Meter Co. at 50 West 50th St., New York, N.Y.

The Joint Research Committee on Boiler Feedwater Studies has suspended the major portion of its activities due to the demands of the war effort on the Committee's members. The Committee will carry on through the secretarial activities of J. B. Romer. The sub-committee under J. H. Walker will carry on its work during 1942. The same roster of officers for the Committee will be kept until the end of the war emergency.

(Continued on page 46)

CUMULATIVE INDEX TO THE JOURNAL AND PROCEEDINGS

1881–1939 Inclusive

The Cumulative Index to the Journal and Proceedings of the American Water Works Association is ready for its place on your shelves, where it will render your bound volumes of these publications far more useful for ready reference. After this edition was printed the type was torn down, and future indexes will commence with the issue of January, 1940. Get your copy *now*. Price to members, $1.75; to members for cash with order, $1.50; to non-members, $2.00. Write to—

The American Water Works Association
22 East 40th Street, New York

ANNOUNCING . . . .

THE THIRD ANNUAL CONVENTION

OF

The Federation of Sewage Works Associations,
Cleveland, Ohio, - October 22nd, 23rd, 24th, 1942

THE ANNUAL CONVENTION ISSUE of
SEWAGE WORKS JOURNAL

A Special Issue in place of the Regular September Number will contain all the details of the Convention—Meetings, Exhibits, Entertainment, etc. Articles on plant operations, data on new developments and numerous special advertisements of available equipment will make this issue a constant reference.

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STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

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Main Sales Office: 50 Church Street, New York, N. Y.
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HYDRO-TITE

Reg. U. S. Pat. Off.

A Symbol of Quality

A DEPENDABLE SELF - CAULKING JOINT COMPOUND

(Continued from page 44)

SOUTHEASTERN SECTION MEETING

Originally it was planned to hold the 14th Annual Meeting of the Southeastern Section in Savannah, Ga., but after the United States entered the war it was the consensus of opinion that instead of having a three-day Convention, it would be more consistent with the trend of times to have a one-day conference on wartime problems; therefore, the Conference was held on April 20th in Atlanta, Ga., which is centrally located and can be reached with minimum travel by train, bus or automobile.

About one hundred and thirty water supply engineers, chemists, plant operators and others attended this Conference. Quite a number arrived at the Hotel Ansley, the headquarters, the day preceding the Conference. The golfers played golf and others attended various committee meetings.

Chairman M. G. Stewart of Natchez, Miss., presided at the Conference.

Major W. H. Weir, former Associate Sanitary Engineer, State Department of Health, Atlanta, discussed the Georgia Water Works Emergency Mutual Aid Plan. A feature of this plan is that all public utilities are co-ordinated in the organization. The water works division of the plan is divided into ten districts, with a water works utility member in charge of each district. Through the central officer, Major Weir, all of these districts could be co-ordinated, in the event of an emergency. The discussion from the floor on this program indicated considerable interest in the Georgia plan by those attending the Conference from States which have not adopted similar plans.

"Chemical Control of Water Supplies Under War Conditions" was discussed by Dr. Harold B. Freidman, Professor of Chemistry, Georgia Tech., and Chemical Warfare Division of the U.S. Army. The discussion on this subject centered around possible contamination of water supplies by various poisons and gases; what tests should be made to determine the presence of these; and what should be done if they are found to be present.

"Bacteriological Control of Water Supplies Under War Conditions" was discussed by H. A. Wycoff, Professor of Public Health Engineering, Georgia Tech. The question arose, "How much chlorine should be used to insure a safe water delivered to the customers?" It was brought out that through the use of chlorine alone there will not be enough residual throughout the system to guard against typhoid, ordinary dysentery and cholera. Some recommended the use of one part ammonia to three or four parts of chlorine.

"Municipal and Industrial Water Supply Protection" was discussed by F. R. Hammack, Special Agent in Charge, FBI, Atlanta. The discussion from the floor centered upon protection of large water plants and what was being done by the various cities and towns in the southeastern section.

(Continued on page 48)

SAVE FOR DEFENSE

EVERYWHERE Americans are being asked to "SAVE FOR DEFENSE." Water works superintendents, engineers and public officials can do more in this connection by investigating the National Method of water main cleaning. This method restores the carrying capacity of pipe to at least 95 per cent of that of new mains, thereby eliminating the necessity for purchase of new mains. Aside from this the National Method makes possible lower pumping costs, greater delivery, reduced insurance rates and clean water.

Now is the time to do your part—SAVE FOR DEFENSE

National Water Main Cleaning Co.

30 Church St., New York, N. Y.

BRANCHES

115 Peterboro St., Boston, Mass.
910 William Oliver Bldg., Atlanta, Ga.
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BUILDERS VICTORY VENTURI

Meters and Controllers, installed on many Army and Navy projects, are doing their share in supplying potable water to our boys wherever they are serving "Old Glory."

BUILDERS - PROVIDENCE, INC.
(DIVISION OF BUILDERS IRON FOUNDRY)
PROVIDENCE RHODE ISLAND

(Continued from page 46)

"Procurement of Essential Water Works Material" was discussed by Harry E. Jordan, National Secretary, American Water Works Association. Mr. Jordan reviewed the efforts being made by the A.W.W.A. to obtain allocation of the necessary materials for water plant operation, and stressed the fact that for the duration there would not be any hope of obtaining supplies as usual, but only such supplies as were absolutely necessary to keep the plants operating.

"Superintendents War Emergency Round Table" was conducted by B. P. Rice. This discussion was primarily on what was being done to prepare for temporary repairs to water systems, in the event of bombing. This brought out a number of suggestions and information as to the different types of repair sleeves and other special fittings, now being manufactured by various plants for temporary repairs.

The business meeting of the Southeastern Section was held during the luncheon, which was served on the roof of the Ansley Hotel. The following officers were elected for 1942–43: George H. Sparks, West Point, Ga., Chairman; D. S. Abel, Montgomery, Ala., Vice-Chairman; T. M. Rogers, Easley, S. C., South Carolina Trustee; H. M. Mathews, Thomasville, Ga., Georgia Trustee; and B. P. Rice, RFC, Atlanta, Secretary-Treasurer.

The other officers, whose terms had not expired, are as follows: Guy H. White, Columbia, S. C., National Director; J. T. Pinkston, Meridian, Miss., Mississippi Trustee; and W. W. Pointer, Troy, Ala., Alabama Trustee.

W. D. Moore, President, American Cast Iron Pipe Co., Birmingham, was selected for the George W. Fuller Award.

W. L. Avrett, Jr., Chairman of the Membership Committee, reported a total membership of 162 as of January 1, 1941 and 197 as of May 1, 1942.

The Secretary reported that after it was decided to hold the Conference in Atlanta, he sent cards to all members, requesting that they return these cards, indicating whether they would attend or not, and out of the 197 he received 176 replies.

It was decided that if it is impossible to have a Convention, a similar meeting be held in 1943.

B. P. Rice
Secretary-Treasurer

PREVENT WEAR AND CUTTING of rods, plungers and shafts by using



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An Ideal Packing for Water Works and Sewage Pumps and Valves

MABBS HYDRAULIC PACKING COMPANY, *Inc. 1892*
431 S. Dearborn St., Chicago, Ill.

APPLICATION FOR MEMBERSHIP
IN THE
AMERICAN WATER WORKS ASSOCIATION

22 EAST 40th ST., NEW YORK

Date:.....

..... hereby make application for
(I or We)

.....
(Active, Junior, Corporate or Associate Membership, or Affiliate)

in the American Water Works Association, and enclose herewith the sum of $....., one year's dues in advance.

Name.....

Company or Department.....

Title or Position.....

Address.....

.....

If application is for Junior Membership, give date of birth.....

If application is for Affiliate, state number of active services in property where employed.....

Nature of business or character of work (for office records) .....

.....

.....

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If application is for Corporate or Associate Membership, it must be signed by the person designated to represent the firm or corporation in A.W.W.A. activities.

.....
Signature of Applicant.

Application obtained by:

.....

.....

(over)

ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, $10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

NEWS OF THE FIELD

Evidences of changes in policy, changes of fundamental importance, appear in acts of the War Production Board staff as they become known from day to day. It is hard to say whether or not public announcements of all these changes have been made because the volume of orders and interpretations issuing from the War Production Board can easily consume all the time of any person who attempted to study each one carefully.

But the public press has carried recently a series of statements that strongly imply two ideas. The first is that even with the tremendous expansion of production capacity in the United States, the military requirements are so great as to necessitate substantial restriction of civilian consumption. The other is that the military and lend-lease agencies have, it is said, been given a six-month period of unimpeded use of the highest priority classifications to the end that the men in service have made available to them what they need to carry on the battles for the free ways of life.

Public water supply operations, which we carry on as servants of the American people, have been considered to be among the most essential civilian activities. Public health and safety have been stated by War Production Board authorities to be primary among their considerations. Lately we have heard of a newer yardstick—"Will it fly? Will it float? Will it shoot?"—as a criterion for production. Many people have long ago pointed out that a war against totalitarian powers calls for total effort on our part. Should we not properly, as water works men, examine every detail of our operations with two questions in mind: Must it be done now? Will it contribute to the war effort? Many things have been done by water works executives in time of peace and in a land of plenty that were proper, and well considered. But facing total war as we now do, we must view from a new position the things that are done. One of the reasons why we must put ourselves into this new position is that, with few exceptions, metals that are used in civilian services are made available to them only by restricting their use in military operations.

No one of us will overlook the fact that civilian support is necessary to the war effort. Neither will we forget that civilian support must be both moral and physical. Physical support of the war effort assumes the ability of civilians to carry on and to produce. There are many things they must have in order to produce. Strip them down, if you will, one by one and you have very little else left when you conclude that water supply must go into the discard. But we must talk of and work in water supply with the frills gone. What is vital? What must be had to maintain water

(*Continued on page 2*)

(*Continued from page 1*)

service in any city? Those questions you and every water works executive must be ready to answer for many months to come.

We have had to take counsel with each other and plan both to bring stocks of repair materials down to the approved level and to aid other water works by making surplus materials available to them. Reducing inventories to approved levels is the prime order of the day, for the very plain reason that until adjustments are made to the 1940 basis, the powers that control water works allocations are likely to assume that a continuous flow of repair material is not needed by water works. While at the end of June, the reports from the larger plants showed a still further increase in inventory than did the first quarter's reports, later advice indicates that inventories are being definitely reduced by sales to accredited agencies and that, having been advised of the seriousness of the situation, water works men are putting their stocks in order.

Along the eastern as well as the far western seaboard, mutual aid groups are definitely readjusting their program and filing reports of surplus material that is available to others who may need it. This is commendable. When the practice spreads to every state in the union, water works will be geared to meet the problems that are coming. Let us put it simply. Many water plants are going to have emergencies to meet and will need materials. By no token in the present scene is a person entitled to expect the manufacturers to make spot delivery. The military needs have priority and the manufacturers hands are tied. Neither can a manager build up his stock against anticipated needs. The rules are against it. Plants must share with each other—help each other—and keep essential service going.

The water works executive has no easy job these days. It's a rare community of any size that does not have increased demands to meet. The armed forces have taken away many of the coming young men of the organizations. War industries have taken many others. Guards must be employed to protect vital points about the property. The accounting

(*Continued on page 4*)

Abel Wolman, President of the A.W.W.A., very recently left for South America as a member of the official delegation sent to Brazil by the U.S. State Department. The delegation is under the chairmanship of Surgeon General Parran of the U.S. Public Health Service. The delegation of six members includes three public health experts in addition to Dr. Wolman and also high official Army representatives. Their mission to South America is to meet with similar governmental representatives of most of the Central and South American countries to discuss problems of public health in particular relation to the war and post-war reconstruction.



SALVAGED FOR RE-USE in new location after 50 years' service

CAST IRON MAINS, when abandoned or re-routed, can be salvaged and re-used, thus saving money for the taxpayer. For example, the 16-inch cast iron pipe shown above had served the City of Roanoke, Virginia, for 50 years in its original location. Last year it was removed to make way for a new armory and relaid in a new location to serve out its full life of more than a century.

We have on file many records of old cast iron mains which have been taken up and re-used, or sold to other cities for re-use, or sold as scrap. It is impossible to foretell future requirements or population shifts in metropolitan cities but any public official can be sure that, when water or sewer mains must be abandoned or re-routed, the pipe can be salvaged or re-used if it is cast iron pipe.

Pipe bearing this mark is cast iron pipe. Available in diameters from 1¼ to 84 inches.

TRADE MARK REG.

CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER
1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

CAST IRON PIPE
PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

staff is busy with a lot of new reports to be filed. But the public expects service as always—and is still getting it. Restrictions and rationing may have to come in many cities. Perhaps the time is close when water plant managers who understand the critical supply situation should find a way to let the customers know something about it. Customers will co-operate if they understand.

In the meantime, with the "Save, Stretch and Share" suggestions in which President Wolman and Past President Howson join elsewhere in this issue of the JOURNAL, the safe objectives for water works managers are briefly stated. If those suggestions are followed, no more can reasonably be asked of water works men.—HARRY E. JORDAN, *Secretary, A.W.W.A.*

Raymond Clapper's column in the New York World Telegram for August 20 bears out in the general war production field what we are finding obtains specifically in the water utility field:

Production 'Bugs' *By Raymond Clapper*

WASHINGTON, Aug. 19.—War production figures for July should be coming out soon and indications are they will show up rather well. June was a bad month, but in July some lines went ahead of schedule.



One gets dizzy in the din around here. But so far as I can shake down the essential facts the production job is going well, but not as well as it could. We can feel pride, but not complacency, in the achievement.

With that said, the defects can be emphasized without getting out of focus. The defects are serious. They will tax all of the drive and ingenuity that Donald Nelson has. He knows it. He will need a lot of help.

• • •

First attention is now going to raw material shortages. Our war plants can chew up more materials than will be available in the last half of this year. Steel, for instance, will be several million tons short of needs. A decision had to be made as to how to spread it. Instead of spreading it thin over the whole program, the program has been broken down into groups.

First come those fighting weapons needed this year by American fighting forces. Raw material sufficient for those needs will be supplied no matter what else suffers, and a lot else will suffer. You may see some idle war plants. But that will be a sign that the material which they otherwise would use is going into fighting weapons needed now.

Second, whatever material is left over from the immediate needs for fighting equipment will be available for the bare essentials of the civilian economy. That doesn't mean morale stuff, or things to make people comfortable. It means repairs for locomotives and freight cars, for mines whose copper or nickel is urgently needed. It means chlorine for water systems to prevent epidemics. It means only such materials as are needed to prevent a breakdown behind the lines. Some debate occurred over this group. The services probably would rather not have had this category included. WPB felt that it was essential to prevent a breakdown that might seriously interfere with urgent production, and that view has prevailed.

Third on the list come those important but secondary needs. New locomotives, new freight cars, extra equipment which would be desirable but which can be sacrificed if necessary.

• • •

That is the order in which short raw materials will be made available. Expediters are being assembled to check the flow of these materials, to see that they go out in accordance with this program and only in amounts currently required. The job there is to squeeze the fat out of inventories, to be sure that no stocks of short materials lie around waiting for future use.

Closely related to this is the scheduling of the flow, so that the expediters will know exactly how much of a given material is needed at a given plant and when. Germany has only 5 per cent of the world's nickel and gets along. Our side has 95 per cent of it and still is short. The trouble is bad management of the supply. This problem has been long neglected and we are now suffering. It is being corrected.

Another thing is that American and British war production must be looked at as one. That approach was the purpose of the recent visit of Oliver Lyttleton, British war production chief here. Take steel again for illustration. If we send unfinished steel to England instead of making it up into war weapons here, we lost the scrap—averaging about 15 per cent of the tonnage. We are short of scrap and can ill afford to lose that amount. Yet unfinished steel can go over as ballast and therefore does not take up cargo space. Cargo space is the tighter bottleneck. So the dilemma is resolved in favor of sending as much steel as possible in ballast to save cargo space for other finished war material. The object is to get the maximum of war equipment across. That must always be the controlling factor.

(*Continued on page 6*)

THE GREEN GODDESS



Chlorine has been aptly termed the Green Goddess. Penn Salt is glad to have an important part in making her services available for our war effort.

But she is essentially a peace goddess, for in thirty-odd years of purifying public water supplies, chlorine has performed a humanitarian service in public health protection.

And, as a bleaching agent widely used in the paper industry; for organic synthesis, and many other chemical manufacturing processes, it has definitely earned Industry's appreciation.

Penn Salt takes particular pride in the fact that, in 1909, its Wyandotte, Michigan works shipped the first tank car of liquid chlorine in the Western hemisphere. And now, as then, Penn Salt is exploring new possibilities for chemical service.

PENNSYLVANIA SALT
MANUFACTURING COMPANY
1850 *Chemicals* 1942
1000 WIDENER BUILDING, PHILADELPHIA

CHEMISTRY IS THE KEYSTONE OF INDUSTRY

BRANCH OFFICES: NEW YORK • CHICAGO • ST. LOUIS • PITTSBURGH • WYANDOTTE • TACOMA. PLANTS: PHILADELPHIA • EASTON • NATRONA • WYANDOTTE • TACOMA • PORTLAND, ORE.

(*Continued from page 4*)

Water is recommended as the primary agent for controlling fires that might result from possible incendiary bomb attacks on American cities, according to a special bulletin distribution by the National Board of Fire Underwriters which quotes a statement authorized for reproduction by Director James M. Landis, of the Office of Civilian Defense.

"In recent months a great variety of 'bomb extinguisher' powders have been offered for sale to the public," says the bulletin. "Based on wide experience abroad and tests conducted in this country, commercial powders, sand, talc, and similar agents are at best considered as limited to use in places where there is little danger of fires of serious nature. Many commercial powders have been tested but none has been found to be materially better than sand, dry dirt or ashes. Therefore, unless cost is negligible, they are not to be recommended. Furthermore, they engender a false sense of security in the minds of civilians, thus endangering lives in the event of an incendiary bomb attack.

"In an incendiary raid the enemy may use any one of a number of types of bombs, all designed to start fires. For this reason, fire equipment for civilians must be of the type to fight fire itself and not merely to deal with a particular bomb. Water is, therefore, recommended as the primary agent for fire control.

"Devices such as scoops, grabs, and snuffers have also been widely advertised. These have been found to be of no practical value for civilian use, and in most cases equipment improvised in the home is adequate."

Laboratory studies of "Fibrex," the new joint calking material, indicate that the material has little capacity to support bacterial growth. This is in sharp contrast with the conditions that develop when traditional calking fibers are used. The published studies of such men as Anderson, Calvert, Kingsbury and Adams as well as numerous others have indicated that the vegetable fibers in calking material tended to support bacterial

(*Continued on page 8*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

ZEOLITE CHEMICAL CO.
90 WEST STREET NEW YORK, N. Y.



Gravity Water Pressure for Training Camps

Many of our earlier training camps, built when steel was not so critical, are provided with gravity water pressure from elevated steel tanks. This one has a capacity of 500,000 gals. and supplies a camp with facilities for 8,000 men.

CHICAGO BRIDGE & IRON COMPANY

BIRMINGHAM CHICAGO DETROIT WASHINGTON
PHILADELPHIA NEW YORK HAVANA CLEVELAND
SAN FRANCISCO HOUSTON TULSA GREENVILLE

(*Continued from page 6*)

growth to a serious extent. The introduction of a processed material of the Fibrex type is therefore not only timely, but in the long run, constructive.

In the installation and repair of lead water service pipe, wiping solder having a tin content of up to 38 per cent can be used until January 1, 1943, by public utilities, under an amendment to Conservation Order M-43-a, issued by the War Production Board on August 4. Under the amendment, production and use for all purposes of such solder was permitted until September 1. This amendment modifies the terms of the original order which prohibited the manufacture or use after June 30 of wiping solder having a tin content of more than 30 per cent.

"War Facts" is a handbook on war production recently issued by the Office of War Information, which says of the book, "The material has been compiled to help speakers explain the scope, nature, and effect of the production program and to give Americans in all walks of life an idea of what their contributions can be.... Thus, the subject matter concerns not only the mobilization of our manpower, machine power, and materia!

(*Continued on page 10*)

Emergency Alternate Specifications

for

Sulfate of Alumina

Adopted by A.W.W.A. Board of Directors, June 25, 1942

Published in the July Journal, pp. 1073-74

These specifications are designed to permit specified purchasing of sulfate of alumina made from low-grade bauxite. Inasmuch as all high-grade bauxite is urgently needed for war production, it is highly important that alum meeting the Emergency Alternate Specifications be used wherever it is possible and obtainable.

Single copies of these specifications are available from A.W.W.A. headquarters at 10 cents per copy. Special prices for large lots given upon request.

AMERICAN WATER WORKS ASSOCIATION

22 East 40th St. New York, N. Y.

IS YOUR SCRAP "HIDING"



FROM OUR FIGHTING MEN?

THE SCRAP SITUATION IS SERIOUS. Waste materials—scrap metals, rubber, and all the rest—are desperately needed for our war effort. It takes about a half-ton of scrap steel and a half-ton of pig iron to make a ton of new steel for vital fighting equipment.

How much scrap is needed? Six million tons *more* than can be obtained from regular sources of scrap. War production will suffer, and battles may be lost unless these *extra* tons are collected. But it doesn't stop there. The effort must be kept up as long as the war lasts.

All scrap collected will be purchased by the steel industry at government-controlled prices.

Are you set up to do your part? Do you have a salvage committee for every department with a wide-awake man in charge . . . a salvage "clean-up" day every week . . . a plan to scrap all obsolete equipment and worthless parts? Remember, no piece of scrap is too small. Every pound turned in will help relieve the continuing shortage.

We're all in this together and the only way out is to *get together.* Turn in your scrap — today. The American Rolling Mill Co., 2711 Curtis Street, Middletown, Ohio.

ARMCO

TURN IN ALL YOUR SCRAP

This advertisement is in support of the Salvage Program of the Conservation Division of the War Production Board.

(Continued from page 8)

resources but also the readjustments and sacrifices which have had to be made and will have to be made on the home front."

One of the book's two parts includes three separate statements covering the overall production effort and a description of the priorities machinery. Following this section is a series of 16 shorter statements, about 1,000 works each, under these titles: Conserving for War, Production for War, Materials for War, Building the Ships, Moving the Armaments, Subcontracting for Victory, Conversion, Getting a Contract, The War Production Drive, Our Stake in the Pacific, Our Stake in the South, Labor Mobilizes, Labor's Contribution to the War, Lend-Lease for Victory, Controlling the Cost of Living, and Rationing for Democracy.

Copies are available from the Bureau of Public Inquiries, Office of War Information, 1400 Pennsylvania Ave., N.W., Washington, D.C.

Exemptions to the transportation tax *must* be claimed at the time each ticket is issued, according to a recent ruling of the Bureau of Internal Revenue. Evidence, in the form of a properly executed exemption certificate (Form 731), must be presented at the time the ticket is issued and

(Continued on page 12)

"STOP"
says
RUSTA RESTOR
TRADE MARK REGISTERED
PATENTED
PATS. PEND.
to
RUST IN STEEL TANKS
Rusta Restor is the positive method of preventing rust in all types of steel tanks and riser pipes (the electrical method)
RUSTA RESTOR CORP.
1440 W. State Street
FREMONT OHIO

M H
HIGH QUALITY
VALVES
HYDRANTS
M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.

MR. CITY COMMISSIONER



Can you do this balancing trick?

Can you make the taxpayer's dollar and his individual water supply balance—on the city budget over a period of years? No?

Then it's time to Centriline!* High time to recondition the interior of those water mains—to remove the clogging growth of tuberculation, the scars of corrosion. Once those agents of time and wear have gotten a foothold on the pipe wall—down goes the carrying capacity and the efficiency of your water system. Off goes the balance! Time to put on a slick new lining the Centriline way; an inner jacket of protective cement that will permanently resist the invasion of tuberculation and corrosion and that will restore and maintain a high carrying capacity.

Recondition now and cut depreciation and pumping costs to a minimum. Presto—your main will be as good as new—that budget will balance. Let our steady, experienced hand show you how.

CENTRILINE PROCESS

CENTRILINE CORPORATION

142 CEDAR STREET • NEW YORK, N. Y.

**The Centriline process is a rapid and economical method of reconditioning pipe lines of 30" and more. It consists of first cleaning the main and then applying, by centrifugal force, a dense cement mortar lining of required thickness, mechanically troweled to a smooth finish.*

RESTORES AND PROTECTS PIPE-LINE CARRYING CAPACITY

(*Continued from page 10*)

the transportation receipt signed. Such exemption is provided for employees of municipalities and governmental units when on civic business with the expenses paid by their employer. Credential in the form of a certification of the employee's bona fide employment and his being on official business is required.

O. E. McGuire is now employed as Designing Engineer of the Sanitary Division of the Green River Ordnance Plant, Dixon, Ill. The J. L. Simmons Co. and Hazelet & Erdal, Chicago, are the contractors of the architectural and engineering construction on the project. Previously Mr. McGuire was in charge of all water supply design at the New Marine Air Base, Cherry Point, N.C. From August 1928 until August 1941, he was Assistant Sanitary Engineer, Bureau of Engineering, Michigan State Dept. of Health.

Capt. C. H. Connell, U.S. Army Sanitary Corps, is now stationed at the Medical Field Service School, Carlisle Barracks, Pa., where he is serving as instructor in the Dept. of Military Sanitation. Capt. Connell has spent

(*Continued on page 14*)



STRONG -TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere

HYDRAULIC DEVELOPMENT CORPORATION

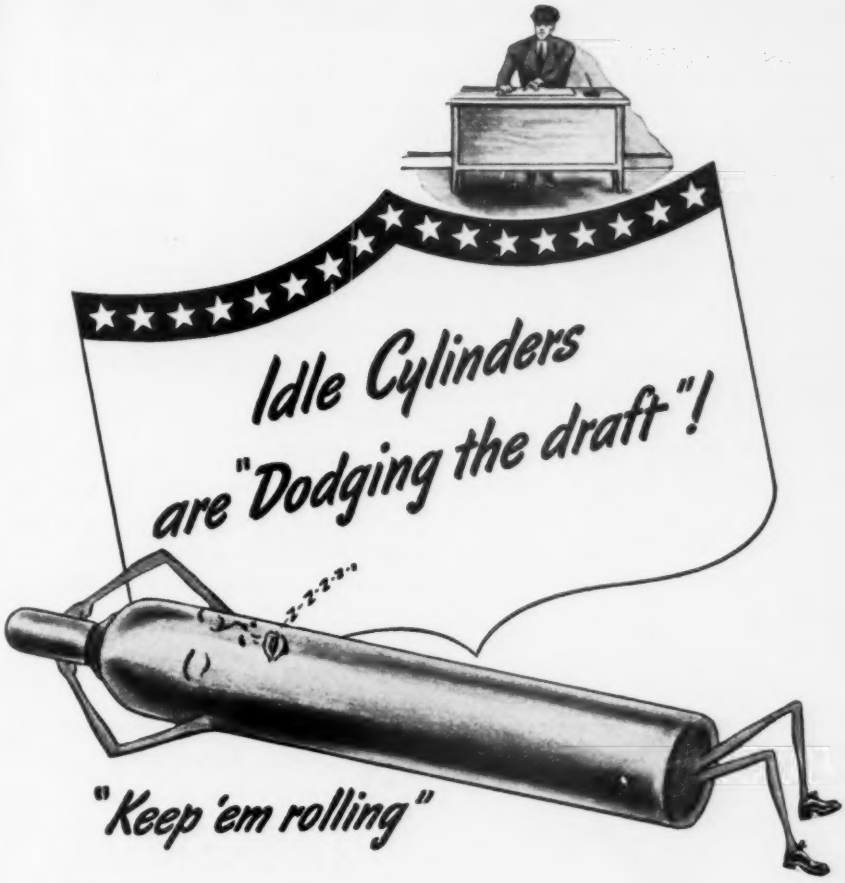
Main Sales Office: 50 Church Street, New York, N. Y.
General Offices and Works: West Medford Station, Boston, Mass

A Symbol of Quality

HYDRO-TITE

Reg. U.S. Pat. Off.

A DEPENDABLE SELF - CAULKING JOINT COMPOUND



● "Deferments" for chlorine cylinders are out for the duration. To conserve steel for Uncle Sam's tanks and battlewagons, the existing supply of cylinders has got to do full-time duty. Mathieson and the chlorine industry can't count on *new* cylinders "as usual."

Do your part by returning your "empties" quickly... regularly. You'll be helping Mathieson to maintain a dependable supply of chlorine for your plant. Don't let idle cylinders "dodge the draft"..."Keep 'em rolling!"

THE Mathieson Alkali Works (INC)
60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

(*Continued from page 12*)

the past year as Camp Medical Inspector, first at Camp Wallace, Tex., then at Camp Swift, Tex. Previously he was Associate Professor of Sanitary Engineering at Texas A. & M. College.

D. H. Caldwell, who has been Instructor in Sanitary Engineering at the University of Illinois while completing work for a doctor's degree in engineering during the past year, is now Director of the Research Laboratory for the Bureau of Sanitary Engineering, California State Dept. of Health. Before his last year at Illinois, he spent 3 years as Research Assistant in Sanitary Engineering, publishing several papers with Prof. H. E. Babbitt on hydraulics of sludge flow.

T. H. Milford is now Chief Engineer and Director, Bureau of Sanitation, Alabama Dept. of Public Health. For the past two years Mr. Milford has been associated with the J. W. Goodwin Engineering Co. as Chief Engineer. Mr. Milford was previously associated with the Alabama Health Dept. and was Assistant Sanitary Engineer when he left in August 1940.

(*Continued on page 16*)



Fire fighters of two generations know that Kupferle Fire Hydrants always work. Quality and precision manufacture prove their worth in performance.

Specification sheets on request

JOHN C. KUPFERLE FOUNDRY CO.
St. Louis

KUPFERLE
FIRE HYDRANTS

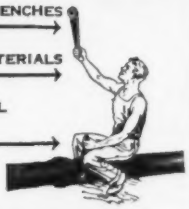
3 *Money, Time and Labor Saving Features of*

UNIVERSAL
CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.



For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

Dept. C
THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

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STREET_____

CITY_____

BARRETT ENAMEL—FOR COMPLETE UNDERGROUND PROTECTION



Owen River Aqueduct, Los Angeles Department of Water and Power. Barrett Enamel.

FIELD SERVICE—The Barrett Waterworks Service Department and staff of Field Service men stand ready to provide a broad measure of cooperation. These services include consultation on technical details, training of crew, and job inspection.

Barrett WATERWORKS ENAMEL

● Inexpensive and easy to apply, Barrett Waterworks Enamel provides uniform, nonconducting coating that forms a hard, mirror-like finish to give an exceptionally high coefficient of flow.

Barrett Enamel meets the standard specifications of the American Water Works Association. It is dielectric, water-tight, and resistant to corrosion and to mechanical distortion. Made from the most stable bituminous material known for underground pipe protection, it maintains capacity at the peak and keeps yearly upkeep costs at a gratifying minimum.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK

(*Continued from page 14*)

Clair N. Sawyer, who for the past 2 years has been Asst. Professor of Sanitary Chemistry and Biology in New York University's Dept. of Sanitary Engineering, has accepted employment offered by a special committee appointed by the Governor of Wisconsin to study certain undesirable developments in the pollution of Wisconsin's lakes. The survey is mainly concerned with fertilization of the receiving bodies of water, rather than with the usual stream pollution.

Henry Nunn has been given a leave of absence from the position of Superintendent of the Van Buren, Ark., Water Dept., to join the U.S. District Engineers at the Sunflower Ordnance Works, De Sota, Kan. Fay Peer will be Acting Superintendent until Mr. Nunn returns.

Franklin H. Robbins, Designing Engineer for New York City's Board of Water Supply, Gas & Electricity, retired on September 1. He had been with the Board of Water Supply since 1907. His duties were chiefly the designing of gate chambers, tunnels and miscellaneous structures, and making investigations.

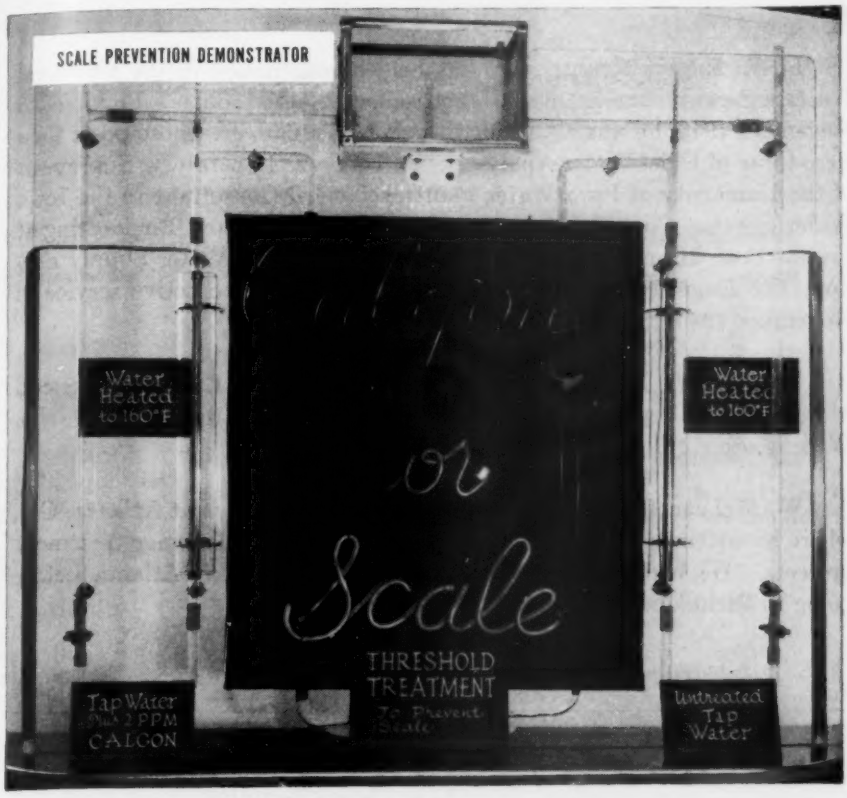
(*Continued on page 18*)

Keeping Up To Date On Membership Listings

Do you keep up to date on the whereabouts of your business associates and friends in the water works field? Have you noted that the "Changes in Membership" listings have, since July, appeared in the News of the Field section of the *Journal*, in the same format as The 1942 Membership Directory, which was issued in June?

"Changes in Membership" and "Changes in Addresses" are now arranged so that you may clip and insert the listings important to you in your Membership Directory, keeping it up to date from month to month. Water works men are moving from job to job and from job to the armed forces pretty rapidly these days, and you will want to keep up with them. The new "Changes in Membership" listings include a separate list of the men going into the services.

If you have made a change in your own position, don't forget to notify the Association, so that your new address or status may be noted in the listings.



SEE HOW CALGON PREVENTS SCALE IN HOT-WATER HEATER COILS

THIS apparatus, shown at the recent A.W.W.A. Convention in Chicago, gave a dramatic visual demonstration of how Calgon prevents scale in hot-water heater coils.

All the water used in the demonstration was Chicago city water with a small amount of soda ash added to increase the supersaturation with respect to calcium carbonate. On the right side, this water was heated to 160°F. In passing through a Pyrex tube wound externally with wire resistance ribbon, and then flowed through the tubing which forms the word "Scale." Notice the heavy deposit of calcium carbonate which caused this tubing to show up white.

Now look at the word "Calgon." The same water with 2 ppm. Calgon added was heated to 160°F. and flowed through this tubing—but what a difference. The glass stayed crystal clear with no sign of deposit of calcium carbonate.

That is actually what will happen when 0.5 to 2 ppm. of Calgon* is added to your municipal water supply. Calgon Treatment *works*, whether your supply is hard and high in bicarbonate, or lime-soda softened. It is effective right to the ends of the line at temperatures even above those used in ordinary water heaters. Preventing scale is important now with replacement coils difficult to obtain. Let us help you produce a truly trouble-free water.

*Calgon is the registered trade-mark of Calgon, Inc., for its glassy sodium phosphate products.

Calgon solves 4 water works problems

1. **Prevention of scale** from hard, high-bicarbonate waters. Calgon, added at the plant, prevents scale formation in mains, meters and hot-water heaters, throughout the system.
2. **Corrosion control**—Calgon forms a thin protective film on metals and metal oxides at pH values of 5.0 and higher. This reduces the attack of oxygen to such an extent that corrosion ceases to be a problem.
3. **Prevention of "red water"** — Calgon prevents the precipitation of dissolved iron. Thus "red water," either from iron initially present in well water or from corrosion, can be eliminated.
4. **Stabilization of water** following lime or lime-soda softening. Calgon's ability to prevent precipitation of calcium carbonate stabilizes water to the ends of the system.

calgon, inc.
HAGAN BUILDING PITTSBURGH, PA.

(*Continued from page 16*)

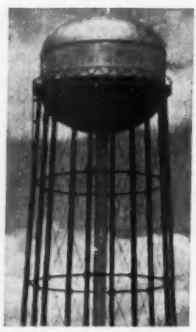
Lt. R. Rupert Kountz, who has held a commission in the Chemical Warfare Service since 1936, has been called to active duty. Previous to November 1940, he was assistant to Jack J. Hinman, Jr. whose posts then were those of Chief Water Analyst, State Hygienic Laboratory; Supervisor of the University of Iowa Water Plant; Technical Consultant to the Iowa Water Service Co.; and Associate Professor of Sanitary Engineering at Iowa. Prof. Hinman, now Lieutenant-Colonel, Chief Water Supply Section, The Engineer Board, Fort Belvoir, Va., went into active service in November 1940, and Lt. Kountz carried on his work.

Charles W. Hoy, formerly Vice-President and Engineer, General Management Corp., New York, is now Engineer for the Boise, Idaho, Water Corp.

W. McLean Bingley has taken up new headquarters at Atlanta, Ga., where he continues work for the Dorr Co. on water and sewage treatment projects. He had previously made his headquarters at Atlanta before going to Richmond, Va., in 1939.

(*Continued on page 20*)

STOP RUST
with
RUSTOP



Cathodic Protection ends rust
•
Cleans old tanks
•
Keeps new tanks clean
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No paint—No taste
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Write for estimate

ELECTRO RUST-PROOFING Company
29 W. Apple Street
Dayton, Ohio

FOR
Quick Repairs in DEFENSE Emergencies!



For wartime emergency-breaks in pipe lines, this Doublex Simplex Split Sleeve will enable you to make quick, economical, effective repairs. You should have a supply of several of each different size that you might need. Thousands in use, some for 13 years. Order now from shipping point nearest you as follows: Birmingham, Dallas, Kansas City, Los Angeles, Minneapolis, San Francisco, Pittsburgh.

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM, ALA.
New York City Chicago Los Angeles San Francisco
Pittsburgh Kansas City Minneapolis Dallas Cleveland

1ST.



SIMPLEX is proud of its leadership in the development of inherently sound Water Works and Sewage Equipment.

- Master Summator
- Balanced Valve Controller with constant Area Piston
- Vertical Controller
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- Air Release Valve for Sewage

In combination with Simplex primary devices and MS and MO Meters this equipment is being specified by an ever increasing number of design and operating engineers. Before you buy, examine the "Firsts" by Simplex.

SIMPLEX VALVE & METER COMPANY
60th & UPLAND STREETS, PHILADELPHIA, PA.

(*Continued from page 18*)

Philip L. McLaughlin, formerly Sanitary Engineer for the West Virginia Water Service Co., Charleston, W.Va., is now Lieutenant at the Naval Construction Training Center, Camp Allen, Norfolk, Va.

John Cameron MacGregor, formerly Manager of the Jewell Filter Co. at Calcutta, India, is now Captain in active service with the Indian Corps of Engineers.

Arthur W. Consoer and John A. Fulkman of Consoer, Townsend and Quinlan, Architect-Engineers, have been in Madison, Wis., since mid-April. Mr. Consoer is in charge of all work for Consoer, Townsend and Quinlan who are architect-engineers for the Technical Training Command Radio School at Madison. Mr. Faulkman is Water Supply Engineer.

C. F. Garland is now serving as Lieutenant, U.S. Army Sanitary Corps, Camp McCain, Grenada, Miss. Lt. Garland was formerly Assistant Sanitary Engineer, Bureau of San. Eng., Florida State Board of Health.

(*Continued on page 22*)

Still Wanted:

The Third Edition of
Standard Methods of
Water and Sewage Analysis

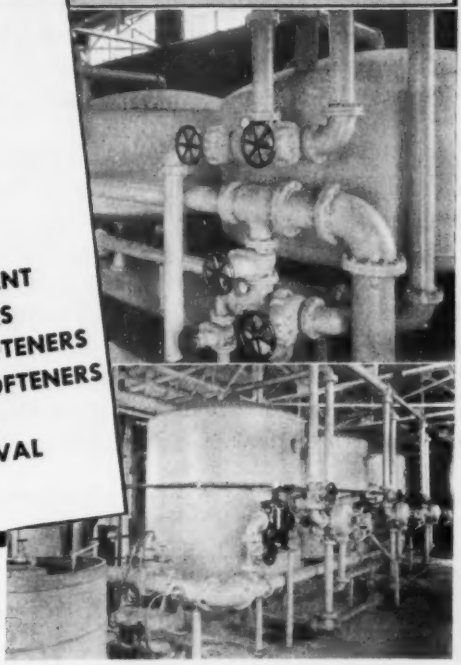
Last April a News of the Field Item announced the Association's interest in obtaining four of the old editions of *Standard Methods.* These were wanted to complete a file on this book which begins with the first typewritten draft for the first edition. Copies of all editions except the third have been obtained. Anyone wishing to sell a third edition should write the A.W.W.A. directly.

AMERICAN WATER WORKS ASSOCIATION
22 East 40th St. New York, N. Y.

Check with Graver - FIRST!

- ☐ AERATORS
- ☐ CHEMICAL FEEDERS
- ☐ CHEMICAL PROPORTIONERS
- ☐ CLARIFIERS
- ☐ FILTERS
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Above is only a partial list of Graver Water Conditioning Equipment. Write for full details on your requirements.



TOP PHOTO—*Graver Pressure Filters.*

BOTTOM PHOTO—*Graver Zeolite Water Softeners.*

WHATEVER your requirements may be, if they have to do with water conditioning, you'll find it to your advantage to consult Graver first.

For more than thirty years Graver has designed and manufactured water conditioning equipment of all types and has an enviable record of achievement in both the industrial and municipal fields.

And so, when we say, "Check with Graver", we simply mean, take advantage of this experience. It's your assurance of complete satisfaction—of equipment that will meet your individual requirements with the greatest efficiency and economy.

WATER SOFTENERS
FILTRATION SYSTEMS
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CHICAGO
TULSA

42-42-W

(*Continued from page 20*)

Ivory I. Cook, formerly Superintendent of the Water Filtration Plant at Columbus, Ind., is now at the Camp Atterbury Water Plant.

Richard V. Ford of the Ford Meter Box Co. has resigned his position with that concern to enter the armed forces as a Lieutenant in the Navy. Mr. Ford has made his headquarters at Haddonfield, N.J., while the Company is located at Wabash, Ind.

P. J. Rice, former Filter Plant Operator at the Durham, N.C., Treatment Plant, is now serving as Water Works Supervisor at Camp Butner, Durham, N.C.

Wade Plummer has been appointed Asst. General Manager of the Butte, Mont., Water Co. Mr. Plummer came to the Butte Water Co. after serving with the Marines in the World War and became Superintendent in 1929. He has been a member of the A.W.W.A. since 1925 and is a Past Director—1940–42. John B. Hazen, formerly Engineer, is the new Superintendent.

(*Continued on page 32—Membership Listings on pages 26–31*)

VOGT FIRE HYDRANTS

Standard—
"Traffic Model"—
Flush Type—
Water Crane
Type



VOGT GATE VALVES



Non-Rising Stem—Outside Screw and Yoke—Hub End—Flanged End—Ends to Fit any Type Pipe.

Also—Floor Stands, Shear Gates — Tapping Sleeves and Valves, Flap Valves and Mud Valves.

VOGT BROTHERS MFG. CO.
INCORPORATED
MAIN AT 14th ST.
LOUISVILLE, KENTUCKY

Speed up
YOUR BELL & SPIGOT MAIN LAYING
with this INGOT FORM Jointing Compound

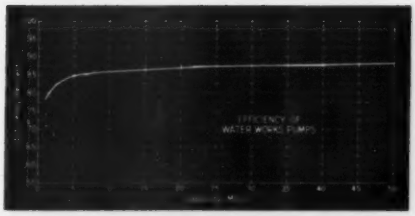
CUT down delays in back-filling and clearing up streets. Thiokol (synthetic rubber) in its sulphur base makes joints of *Tegul*-MINERALEAD show less initial leakage • CUT LAYING AND MAINTENANCE COSTS—In 10 lb. ingots, *Tegul*-MINERALEAD is easily handled, melted and poured; needs no caulking or deep bell holes • The ingot form is waterproof and cannot change composition. *Tegul*-MINERALEAD is super-resistant to thermal and mechanical shock, goes 3 to 5 times as far as lead, conserving a strategic war metal; makes permanently tight joints. Representatives and stock carried in major cities • For further information, address The ATLAS MINERAL Products Co. of Pa., Mertztown, Pa. or The ATLAS MINERAL Products Co. of Cal., Redwood City, California.

Tegul-
MINERALEAD

Sustained PUMP EFFICIENCY keeps power costs down!



Initial high pump efficiency is sometimes obtained by the use of excessively close clearances between wearing rings, but, attained in this way, it is not long maintained, particularly where flat rings are relied upon.



Efficiencies attainable with various capacities at heads between 125 and 225 ft.

DE LAVAL LABYRINTH WEARING RINGS are distinct because, without resort to close clearances, they make possible high pump efficiency, which is maintained over a long interval, as demonstrated, for instance, by two 25 m. g. d. De Laval pumps in the Shawmont Station, Philadelphia.

Unit No. 4 in the acceptance test on January 22, 1927, showed a wire-to-water efficiency of 82.7 per cent and, when tested again on January 20, 1933, an efficiency of 83.9 per cent. Similarly, Unit No. 5 on the acceptance test on March 3, 1927 showed 83.3 per cent efficiency and, when tested again on January 31, 1933, it showed 83.9 per cent.

For further particulars and other instances, ask for Publication P-3225.

DE LAVAL Steam Turbine Co.
TRENTON, N.J.
MANUFACTURERS OF TURBINES · STEAM · HYDRAULIC · PUMPS · CENTRIFUGAL · PROPELLER · ROTARY · DISPLACEMENT · MOTOR-MOUNTED · MIXED-FLOW · ELDUBLEX · SELF-PRIMING · CENTRIFUGAL BLOWERS and COMPRESSORS · GEARS · WORM · HELICAL and FLEXIBLE COUPLINGS

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Consulting Engineers

Water, Sewerage, Industrial Waste, Garbage, Power Plant, and Valuation Problems.

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WATER ANALYSIS
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ALVORD, BURDICK & HOWSON

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Consulting Engineer
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Flood Control – Fire Protection
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Water Supply, Sewage Disposal, Power, Reports
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Changes in Membership

NEW MEMBERS

Applications Received July 1 to 31, 1942
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Bach, Clayton M., Jr., Chemist & Water Bacteriologist, Minneapolis Water Dept., Minneapolis, Minn. (July '42)

Black, Henry R., Assoc. Civ. Engr., Bureau of Water Supply, 2124 Chelsea Terrace, Baltimore, Md. (July '42)

Brewer, Howard Hawley, Civ. Eng. Assoc., Bureau of Water Works & Supply, Box 3669 Terminal Annex, Los Angeles, Calif. (July '42)

Ford, Richard V., Vice-Pres., Ford Meter Box Co., 718 Redman Ave., Haddonfield, N.J. (July '42)★

Fox, Jeff S., Utility Engr., Ford, Bacon & Davis, Inc., 900 Maple St., Terre Haute, Ind. (July '42)

Goldsborough, Donald H., Assoc. Civ. Engr., Bureau of Water Supply, 1904 Homewood Ave., Baltimore, Md. (July '42)

Link, Roy E., Supt., Walnut Park Mutual Water Co., 7216 Seville Ave., Huntington Park, Calif. (Jan. '42)

MacDonald, Alan T., Town Engr., Kentville Water Works Dept., Kentville, N.S., Can. (July '42)

Mays, Ernest H., Supt., Madison Heights Sanitary Dist., Madison Heights, Va. (July '42)

McArthur, L. Sheldon, *see* Texas Water Co.

McLellan, J. B., Asst. San. Engr., State Board of Health, 620 S. Third St., Louisville, Ky. (July '42)

Mejia, Hernando, San. Engr., Apdo. No. 413, Bogota, Colombia (July '42)

Negri, Mario L., Director Tecnico de Provincias y Territorios Nacionales, Obras Sanitarias de la Nacion, Buenos Aires, Argentina (July '42)

Ruehle, Ralph, Meter Supt., Warren Township Water Dept., 8077 Cadillac St., Van Dyke, Mich. (July '42)

Scheffer, Louis K., Dist. San. Engr., State Dept. of Health, 1013 Green St., Harrisburg, Pa. (July '42)

Shepherd, Ralph, Assoc. Civ. Engr., Bureau of Water Supply, 4636 Rokeby Rd., Baltimore, Md. (July '42)

Texas Water Co., L. Sheldon McArthur, Vice-Pres., 112 Baurline St., Fort Worth, Tex. (Corp. M. Jan. '42)

Trelles, Rogelio A., Jefe de los Laboratorios, Obras Sanitarias de la Nacion, Av. Centenario 5950, Buenos Aires, Argentina (July '42)

Tyler, Arthur R., Engr. & Supt., Suburban Water System, 405 City Hall, Honolulu, T.H. (July '42)

REINSTATEMENTS

Campbell, Archie, Supt. of Water Works, Cloquet, Minn. (July '35)

Van Meter, Roy O., San. Engr., Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles, Calif. (Oct. '32)

LOSSES

Resignations

Elliott, Earl C., Pres., California Water Service Co., Box 1150, San Jose, Calif. (July '28)

Hamilton, Louis H., Secy. & Gen. Mgr., Walnut Park Mutual Water Co., 7216 S. Seville Ave., Huntington Park, Calif. (July '36)

Deaths

Killam, Samuel E., Director & Chief Engr., Water Div., Metropolitan Dist. Com., 20 Somerset St., Boston, Mass. (Nov. '15)

CHANGES IN ADDRESS

Changes of address between July 15 and August 15, 1942

Abrams, Norman H., 1014 N. 20th St., Waco, Tex. (Oct. '39)

Acevedo-Quintana, F., Designing Engr., Apdo. 891, Caracas, Venezuela (Jan. '41)

Anderson, A. L., 300 E. Broad St., Falls Church, Va. (Nov. '25)

Antweiler, John J., Engr. of Distr., Cleveland Div. of Water, 9013 Empire Ave., Cleveland, Ohio (Jun '27)

Atkinson, George E., 4851 N. 16th St., Arlington, Va. (Jan. '35)

Bailey, Allen C., Holston Ordnance Works, Municipal Auditorium, Kingsport, Tenn. (July '42)

(*Continued on page 28*)

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(*Continued from page 26*)

Barber, B. P., Box 1116, Columbia, S.C. (Apr. '40)

Barham, G. B., 23 The Drive, Sevenoaks, Kent, England (Affil. Jan. '39)

Barrett, Jack P., Chemist, 113 E. Ruby St., Independence, Mo. (Apr. '40)

Barton, Harry, 539 Lincoln Ave., Bellevue, Pittsburgh, Pa. (Dec. '28)

Bergman, Leonard A., 2405 Colonial Ave., Waco, Tex. (Jan. '38)

Bingley, W. McLean, 87 Sheridan Drive, N.E., Atlanta, Ga. (Mar. '34)

Borton, Fred W., Member of Board, Dept. of Water & Sewers, Box 3741, Miami, Fla. (Apr. '42)

Butler, T. C., Jr., Hydr. Engr., Pomona Pump Co., Route 3, Boise, Idaho (Jan. '40)

Cochrane, John C., Wallace & Tiernan Co., Inc., Box 446, Buffalo, N.Y. (July '35)

Cook, Ivory I., Supt., Water Plant, 1443 Franklin St., Columbus, Ind. (Apr. '41)

Crossman, A. B., Box 1807, Tulsa, Okla. (Oct. '39)

Dillon, S. E., Local Mgr., California Water Service Co., 1417—17th St., Bakersfield, Calif. (May '27)

Ebert, R. E., Chemist, Water Dept., 840 Knollwood St., Winston-Salem, N.C. (Dec. '33)

Eidsness, F. A., Asst. San. Engr., Bureau of San. Eng., State Board of Health, Jacksonville, Fla. (May '41)

Erickson, Wendell J., Asst. San. Engr., State Dept. of Health, 217 Lark St., Albany, N.Y. (Jan. '24)

Ferguson, G. H., Chief, Public Health Eng. Div., 225 Daly Bldg. Annex, MacKenzie Ave., Ottawa, Ont., Can. (Mar. '25)

Fulkman, John A., Water Supply Engr., Consoer, Townsend & Quinlan, 125 Blackstone Ave., La Grange, Ill. (July '28)

Gebhart, Earl, Supt., Middletown Water Works, 116 Baltimore St., Middletown, Ohio (Apr. '39)

Gilkison, Geo. F., Supt. of Water & Sewage, Kansas Ordnance Plant, Parsons, Kan. (Apr. '20)

Goit, Laurance E., Engr.-in-Charge, Water Distr. System, Box 3669 Terminal Annex, Los Angeles, Calif. (Oct. '34)
Goodell Prize '37.

Gullo, S. J., Painesville Coca Cola Bottling Co., Ashtabula, Ohio (Jan. '42)

Hanson, Adellon F., 1737 Cambridge Ave., Cambridge, Mass. (Jr. M. Jan. '41)★

Hoy, Charles W., Engr., Boise Water Corp., Box 548, Boise, Idaho (Jan. '42)

Hum, Clyde, Sales Engr., Pittsburgh Equitable Meter Co., 1222 S. 6th St., Springfield, Ill. (Apr. '41)

Hurdle, Reg. T., Engr., General Delivery, Red Lodge, Mont. (July '26)

Jensen, Emil C., 526 Hutton Bldg., Spokane, Wash. (Jan. '42)

Jones, Roy G., 3726 Walnut St., Bell, Calif. (July '42)

Jorgensen, Homer W., Assoc. San. Engr., U.S. Engr. Office, 1131 Masselin Ave., Los Angeles, Calif. (Oct. '39)

Kelley, W. Denison, Cons. Engr., 1035 Myers Ave., Dunbar, W.Va. (Oct. '40)

Kelsey, Reginald A., Star Route I, Rosamond, Calif. (July '38)

Knott, John J., 3726 Walnut St., Bell, Calif. (Oct. '37)

Laase, William F., 871 Main St., Lewiston, Me. (May '24)

Langton, Bernard, 605 W. Rusk St., Marshall, Tex. (Oct. '41)

Law, Woodruff, R.F.D. No. 2, Box 128, Chardon, Ohio (Jan. '40)

Lyle, Newton B., 4215 Bigelow Blvd., Pittsburgh, Pa. (June '26)

Lyndes, Harry E., Mgr., Technical Service Office, General Chemical Co., Osagè & W. Bayaud Sts., Denver, Colo. (Jan. '41)

Martin, Paul H., 2586 Kent Rd., Columbus, Ohio (Oct. '38)

McCormack, George A., Chief Engr., East Chicago Water Dept., 4907 Magaun St., East Chicago, Ind. (Jan. '41)

(*Continued on page 30*)

Membership Directory Errata

1. Page 2, Column 2 of the "Consolidated List of Members," *for* **American Concrete & Steel Pipe Co.** *read* **American Pipe & Construction Co.**

2. Page 3, Column 1 of the "Consolidated List of Members," *for* **American Pipe & Construction Co.** *read* **American Concrete Pipe Association.**

(**Note:** Both these items are listed correctly in the "Associate Members" list, page 125.)

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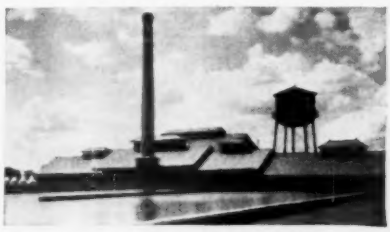
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(*Continued from page 28*)

McCrory, Dean E., Sales Repr., Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa. (Apr. '39)

McKay, W. G., Dist. Engr., Dept. of Pensions & National Health, 304 Blowey-Henry Bldg., Box 234, Edmonton, Alta., Can. (Jr. M. Jan. '42)

Michaels, A. P., 202 Church & Main Bldg., Orlando, Fla. (Aug. '24)
Director '31–'33.

Mikesell, C. C., Sales Repr., Johns-Manville Sales Corp., 297C Argonne Ave., Long Beach, Calif. (Oct. '39)

Milford, T. H., Bureau of Sanitation, State Health Dept., Montgomery, Ala. (Apr. '38)

Miller, H. I., Owner, Pacific Water Works Supply Co., 2900—1st Ave., S., Seattle, Wash. (Jan. '28)

Moore, Russell B., Cons. Engr., 1456 N. Delaware St., Indianapolis, Ind. (Jan. '28)

Moorman, R. L., 216 N. St. George St., Allentown, Pa. (July '39)

Nasi, Kaarlo William, % S. W. Batson, Wayzata, Minn. (Jan. '38)

Nicholson, J. T., Service Engr., National Aluminate Corp., 301 Wachovia Apts., Winston-Salem, N.C. (Jan. '41)

Patterson, James N., Chemist, Box 272, Salinas, Calif. (Oct. '35)

Peabody, James R., 721 Brown Bldg., Louisville, Ky. (Dec. '24)

Pearl, Emanuel H., 526 W. Lynwood, San Antonio, Tex. (Jan. '37)

Peerless Pump Div., E. W. Pierce, Sales Mgr., Box A, Station B, Canton, Ohio (Assoc. M. June '27)

Phillis, Howard D., Box Sec. 3277 Terminal Annex, Los Angeles, Calif. (Oct. '37)

Pingree, L. W., Wallace & Tiernan Co., Inc., 171 Second St., San Francisco, Calif. (Apr. '42)

Pratt, Jack W., % C. L. Pratt, 1425 Santa Ynez Way, Sacramento, Calif. (Jan. '41)

Reinke, Edward A., Sr. San. Engr., Bureau of San. Eng., 15 Shattuck Sq., Berkeley, Calif. (Nov. '23)

Robbins, Franklin H., Designing Engr., 2955 Grand Concourse, New York, N.Y. (Apr. '30)

Roberts, F. C., Jr., 134 S. Occidental Blvd., Los Angeles, Calif. (July '35)

Rothe, H. S., Coca Cola Bottling Co., Dubuque, Iowa (Jan. '42)

Scott, L. H., 8 Putnam Rd., Atlanta, Ga. (Jan. '36)
Fuller Award '40.★

Shawver, G. B., Gen. Mgr., Consolidated Water Co., Inc., Box 229, Athens, Tenn. (Apr. '30)

Sparling, R. W., Box Sec. 3277 Terminal Annex, Los Angeles, Calif. (Assoc. M. Nov. '25)

Thane, H. S., Valley Water Co., Hamilton, Mont. (Apr. '26)

Thomas, H. W., Pacific States Mgr., Badger Meter Mfg. Co., 2371 N. 30th St., Milwaukee, Wis. (Oct. '41)

Thornton, Gustavus, Constr. Engr., Ford, Bacon & Davis, Inc., Box 148, Galveston, Tex. (Apr. '39)

Thorson, Wilbur R., Elec. Engr., 4006 Virginia Ave., S.E., Charleston, W.Va. (Oct. '37)

Universal Construction Co., Box 5805, North Indianapolis Station, Indianapolis, Ind. (Assoc. M. Apr. '41)

Vickrey, John U., Operator, Fort Lauderdale Water Dept., 608 S.W. 7th Ave., Fort Lauderdale, Fla. (July '39)

Waite, Howard, Engr., 549 De Soto, Salt Lake City, Utah (Apr. '40)

Winsinger, O. F., Station B, Box 130, Toledo, Ohio (Apr. '42)

MEMBERS ENTERING MILITARY SERVICE

Coleman, Robert Feaster, Jr., Teaching Fellow, North Carolina State College, Box 5403, State College Station, Raleigh, N.C. (Jr. M. July '41)★

Connell, C. H., 4101 Rosedale Ave., Austin, Tex. (Jan. '38)★

Crane, D. Eugene, Box 6084 Stockyards Station, Denver, Colo. (Jr. M. Jan. '39)★

Garland, Chesley F., Asst. San. Engr., Bureau of San. Eng., State Board of Health, Jacksonville, Fla. (Jan. '42)★

MacGregor, John Cameron, Mgr., Jewell Filter Co., Ltd., Mercantile Bldgs., Calcutta, India (Jan. '39)★

McClane, J. Huston, Hercules Powder Co., Inc., Kalamazoo, Mich. (Oct. '37)★

McLaughlin, Philip L., San. Engr., West Virginia Water Service Co., 814 Peoples Bank Bldg., Charleston, W.Va. (July '28)★

Nunn, Henry E., Supt. of Water Works, Van Buren, Ark. (Oct. '34)★

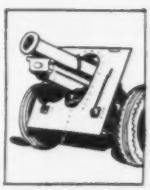
Richey, L. G., City Engr., Box 374, Belmont, N.C. (Oct. '41)★

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(*Continued from page 22*)

Adellon F. Hanson is now commissioned as 1st Lieutenant and is serving as instructor at the Anti-Aircraft Artillery School, Camp Davis, N.C. Before entering service, Lt. Hanson was Engineering Inspector with the East Bay Municipal Utility District, Oakland, Calif.

B. A. Poole, State Sanitary Engineer for Indiana, has been comissioned a Captain in the Sanitary Corps of the U.S. Army. Joseph L. Quinn, Jr., who has been Senior Sanitary Engineer for the Indiana State Board of Health, is taking over Capt. Poole's former duties, in the role of Acting Chief Engineer. Mr. Quinn, who has been with the Board for the past 3½ years, spent 11 years previously with the Indiana State Highway Com. and in municipal work with the cities of Bedford and Indianapolis.

S. Allen McAdam, formerly City Engineer at Lebanon, Pa., is now with the U.S. Engineers' Office, Mercer Co. Airport, West Trenton, N.J.

W. Howard Hopkin, formerly Field Representative, Self Liquidating Div., Reconstruction Finance Corp., Louisville, Ky., has been comissioned a 1st Lieutenant and is on duty as Assistant Post Engineer, Corps of Engineers, Camp Atterbury, Columbus, Ind.

Emil C. Jensen, Senior Public Health Engineer for the Washington State Dept. of Health, is now serving as engineer in both Districts 3 and 4, comprising the eastern half of the state, Robert E. Leaver who covered one of the districts is now on active duty on a reserve commission in the Army.

Anthony Anable, Advertising and Publicity Manager for The Dorr Company since 1932, has been commissioned a Line Officer in the U.S. Naval Reserve with the rank of Lieutenant-Commander. He began active duty on August 14 in an administrative capacity at the U.S.N.R. Midshipmen's School, New York. Commander Anable served as an ensign in the Naval Reserve from 1917 to 1919 aboard one of the first A.E.F. transports. He joined The Dorr Company's staff in 1923. The duties of Advertising Manager at The Dorr Company will be carried on by Albert Morris who has been a member of the staff for five years.

(*Continued on page 34*)

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COOK Deep-Well Turbine Pumps

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BUILDERS

WATER AND SEWAGE WORKS

Equipment

(*Continued from page 32*)

Geo. F. Gilkison, formerly Superintendent of Filtration at Kansas City, Mo., is now Superintendent of Water and Sewage at the Johns-Manville Service Corp., Kansas Ordnance Plant, Parsons, Kan.

"Hydrology," a very substantial and comprehensive volume by Dr. O. E. Meinzer, Chief of the Division of Ground Water, U.S. Geological Survey, has just been issued at the price of $7.50 by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N.Y.

"Industrial Quality of Public Water Supplies in Georgia" is U.S. Geological Survey Water-Supply Paper 912, now for sale by the Superintendent of Documents, Government Printing Office, Washington, D.C., for 15 cents. It was prepared in co-operation with the Division of Mines, Mining and Geology of the Georgia Dept. of Natural Resources. It contains 84 pp. and 1 illustration, a hardness map, and includes 157 analyses of the mineral content of the water of 66 public water supplies.

"Procedure Handbook of Arc Welding Design and Practice" has been issued in the seventh edition by the Lincoln Electric Co., Cleveland, It is 6 x 9 in., has 1,308 pp., including 1,810 illustrations, has a semi-flexible cover of simulated leather, and sells for $1.50 postpaid within the United States, $2.00 per copy elsewhere. This is an enlarged edition of a very valuable book which has gone through 23 printings. The eight sections of the "Procedure Handbook" cover the following: (1) Welding Methods and Equipment, 26 pp., (2) Technique of Welding, 116 pp., (3) Procedures, Speeds and Costs, 119 pp., (4) Weld Metal and Methods of Testing, 30 pp., (5) Weldability of Metals, 98 pp., (6) Welded Steel Construction—Machine Design, 204 pp., (7) Designing of Arc Welded Structures, 274 pp., and (8) Typical Applications of Arc Welding in Manufacturing, Construction and Maintenance, 439 pp.

Calgon, Inc., has opened its own branch office in San Francisco at 149 California St. The affairs of Calgon, Inc., in that region had previously been handled by Griffin Chemical Co. Clyde F. Williamson is Calgon's District Manager and his staff includes: Richard G. Shaler, Joseph R. Shafer and K. J. MacRae.

"Wrought Iron for Sewage Treatment and Disposal Installations" is a 28-page technical bulletin recently published by A. M. Byers Co., Pittsburgh. The booklet discusses corrosion conditions encountered in designing sewage disposal water lines, outfall line service, drainage lines and heating system returns. Descriptions and illustrations of actual installations in numerous cities are given.

(*Continued on page 36*)

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Bacto-Peptone is approved in "Standard Methods of Water Analysis" of the American Public Health Association as an ingredient of culture media for use in the bacteriological examination of drinking water. Bacto-Peptone is rich in the readily available forms of nitrogen required for bacterial nutrition. In a one per cent solution it is sparklingly clear and has a reaction of pH 7.0.

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SAVE FOR DEFENSE

EVERYWHERE Americans are being asked to "SAVE FOR DEFENSE." Water works superintendents, engineers and public officials can do more in this connection by investigating the National Method of water main cleaning. This method restores the carrying capacity of pipe to at least 95 per cent of that of new mains, thereby eliminating the necessity for purchase of new mains. Aside from this the National Method makes possible lower pumping costs, greater delivery, reduced insurance rates and clean water.

Now is the time to do your part—SAVE FOR DEFENSE

National Water Main Cleaning Co.
30 Church St., New York, N. Y.

BRANCHES

115 Peterboro St., Boston, Mass.
910 William Oliver Bldg., Atlanta, Ga.
7103 Dale Ave., St. Louis, Mo.
406 Florida Theatre Bldg., Jacksonville, Fla.
3812 Castellar St., Omaha, Neb.
205 West Wacker Drive, Chicago, Ill.
501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Canada

(*Continued from page 34*)

Recently published is Bulletin #200 describing the complete line of Standard Manometers manufactured by Simplex Valve and Meter Co., 68th & Upland Sts., Philadelphia. Included are details of Simplex Manometers for the measurement of air, water, steam, boiler feed and industrial liquids in the power and process industries, as well as flow, backwash and loss of head in filter plants. Specification details, capacities and method of connection, together with a reference section of useful Manometer data are also given. A copy will be sent upon request to the Company.

"Proceedings of the Second Annual Water Conference," held by the Engineers' Society of Western Pennsylvania in November 1941, is a book of 150 pages of text now available at a cost of $2.15, this amount covering postage. For further information or purchases, address the Engineers' Society of Western Pennsylvania, William Penn Hotel, Pittsburgh.

"Water for Whisky Making (Rail Transport)"—from Parliamentary Debates, July 16, 1941, as reported in the "Official Circular" for June-August, 1941, of the British Waterworks Assn.:

"Mr. John Wilmot asked the Parliamentary Secretary to the Ministry of War Transport whether he is aware that some hundreds of gallons of water from Loch Katrine in Scotland is brought to London by rail each week for whisky making; and whether he will give priority to more important traffic?

"Colonel Llewellin: The first part of my hon. Friend's Question is substantially correct. I have been in touch with the firm concerned, and they have readily agreed to suspend this arrangement for the duration of the war.

"Mr. Wilmot: Is the right hon. and gallant Gentleman aware that great satisfaction will be felt for that answer in many cases where commodities are in short supply owing to lack of transport?

(*Continued on page 38*)

FILTER SAND
99 Per Cent Pure Silica
Washed, dried and manufactured to your specifications
Write for Prices on Bulk, Carload or Bags
Dawes Silica Mining Co.
Thomasville, Georgia

Bring in a New Member
HELP PROMOTE YOUR ASSOCIATION BY INTERESTING YOUR FRIENDS AND CO-WORKERS IN IT.
Send for application blank
American Water Works Assn.
22 East 40th Street, New York



WORTHINGTON
EQUIPMENT FOR WATER SUPPLY

CENTRIFUGAL PUMPS	STEAM AND POWER PUMPS
TURBINE WELL PUMPS	SUMP AND DRAINAGE PUMPS
DIESEL ENGINES	GAS ENGINES
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FEEDWATER HEATERS	STEAM-JET EJECTORS
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MULTI-V-BELT DRIVES	AIR LIFTS
MOORE STEAM TURBINES	SPEED CHANGE GEARS

●

WATER PURIFICATION EQUIPMENT
Water Softeners Pressure Filters

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WATER METERS

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

WORTHINGTON PUMP AND MACHINERY CORPORATION
WORTHINGTON-GAMON METER COMPANY
General Offices: HARRISON, NEW JERSEY *District Offices and Representatives in Principal Cities*

IC1-21

(*Continued from page 36*)

"Mr. Leslie: Does the reply mean that we shall get whisky stronger than before?

"Colonel Llewellin: I understand that that is not the case. London water is to be used instead of loch water.

"Mr. Lawson: Will people who want special whisky have to go to Loch Katrine?

"Colonel Llewellin: We cannot encourage holiday transport for that purpose.

"Mr. McGovern: Would it not save transport if they brought the whisky to Scotland instead of taking the water to England?"

"When in doubt consider the next smaller rating" is a slogan that might well describe General Electric's campaign to point out how materials can be conserved and motor production increased through the selection of motors closer to their ratings for specific jobs. L. A. Umansky, Assistant Manager of General Electric's industrial engineering department, has pointed out that because of "overmotoring" up to 25 per cent more material and labor are now going into the production of motors than is needed for the work the motors are being called upon to do. Motor users and

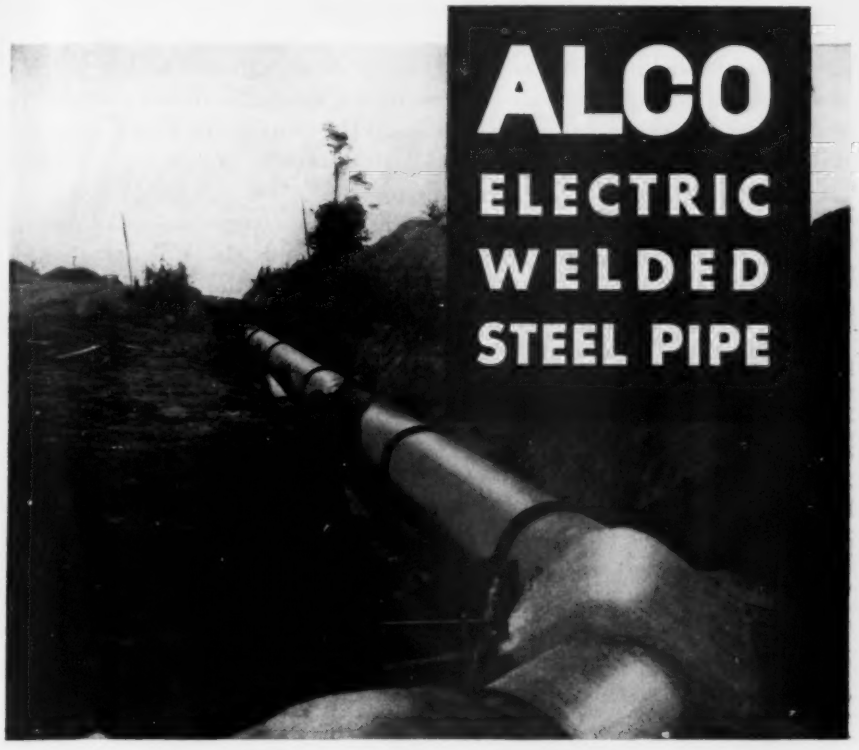
(*Continued on page 40*)

EDSON
DIAPHRAGM PUMPS
Hand Operated--sizes 2", 2½", 3", 4"
Power Operated--sizes 3" and 4"
Open Discharge or Force Pump
Skid, Truck or Trailer Mounted
COMPLETE PUMP OUTFITS
Edson Pumps - Suction Hose
Brass Couplings - Bronze Clamps
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THE EDSON CORPORATION
Main Office and Works: 49 D St., South Boston, Mass.
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Filter Sand and Gravel
WELL WASHED AND CAREFULLY GRADED TO ANY SPECIFICATION.
PROMPT SHIPMENT IN BULK OR IN BAGS OF 100 LB. EACH.
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Peerless Pumps
America's largest selling pumps—for all services in all industries...
Ask for Literature

TURBINE, HI-LIFT AND HYDRO-FOIL TYPES all forms of drive—capacities from 10 to 100,000 g.p.m.
PEERLESS PUMP DIV. • Food Machinery Corporation
Factories: Los Angeles, San Jose, Fresno, Calif. and Canton, Ohio



Alco electric welded steel pipe fabricated in accordance with the latest improved methods is highly resistant to sudden shock and rupture. Alco pipe is low in initial cost and designed for long life.

BUY ALCO
AND AVOID EXPENSIVE REPAIRS

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(*Continued from page 38*)

specifiers can help greatly in conserving critical materials and in helping motor manufacturers produce the maximum number of motors needed to win the war by selecting the motor size on the basis of the actual expected duty without overstress on additional safety factors to take care of unexpectedly heavy loads or to lengthen motor life.

"Conservatism in motor selection, however commendable in normal times, must be discarded for the duration," said Mr. Umansky. "Although modern motors are considerably lighter for the same horsepower than those of a few years ago because of better available materials, they are just as conservatively rated by the manufacturer who has already designed into the motor a margin of safety to meet reasonable overloads."

Mr. Umansky pointed out that "overmotoring" also affects almost everything else in a plant's electric chain including control, distribution, and generation since the capacity of the power system is very often based on the installed horsepower of motors. "For this reason, in the distribution system lies our greatest opportunity to save copper through careful motor selection and, of course, through good system design," said Mr. Umansky.

(*Continued on page 42*)



SAVE MONEY USE ACTIVATED ALUM and BLACKALUM

STUART-BRUMLEY CORP.
516 North Charles St.
Baltimore Maryland

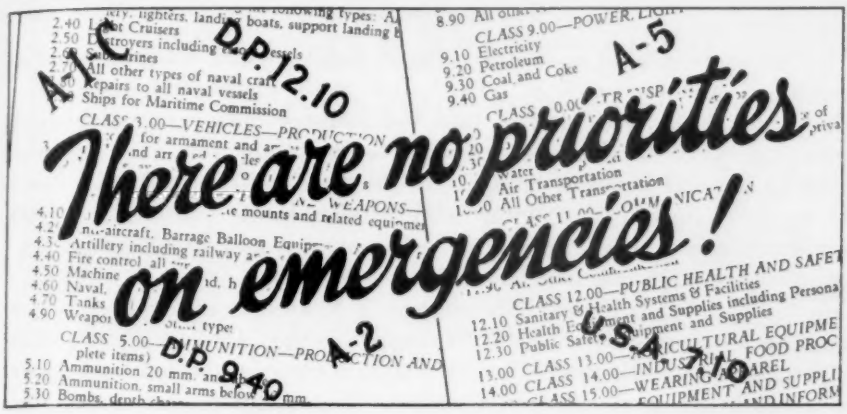
WANTED

Manual of Water Works Practice

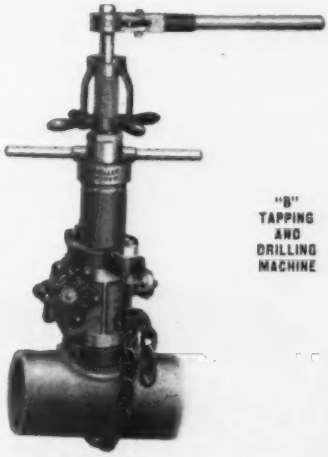
Used copies in good condition

"The Manual of Water Works Practice" is out of print. Do you have a copy which is in good condition and with which you are willing to part. If so, send a post card to A.W.W.A. headquarters, which will forward your offer to prospective buyers.

American Water Works Association
22 East 40th St., New York, N. Y.



Trouble has a way of bobbing up in the most unexpected places and at the most inopportune times. When something breaks down or "rush" connections must be made, then there is no time to order a tapping machine if you don't have one. —That is why we say, "Order your MUELLER Tapping Machine—NOW!" We are busy with war work—forging the implements of victory—and so normal production of our regular items is impossible . . . We have a few of these machines, but after these are gone we can not say when we can fill your order . . . Be ready for those emergencies! Order your MUELLER "B" Machine today, or at least have plenty of repair parts on hand. Putting it off a few weeks may be too late. For more facts drop a card to Dept. W-161.



"B" TAPPING AND DRILLING MACHINE

This machine makes taps and inserts corporation stops in mains under pressure, and will make taps only from ⅜" to 2½" in dry mains. Is normally used on plain cast iron pipe from 4" to 48", but with suitable equipment may be used on other sizes of steel and wrought iron pipe. And with a power clevis the machine may be used on pressures up to 400 lbs. per sq. in. . . . Saves its first cost over and over in time and money.

MUELLER CO.

DECATUR, ILLINOIS

(Continued from page 40)

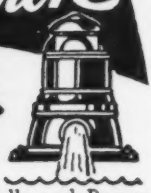
"In any electrical installation, only a small portion of copper used is contained in motor windings. The bulk is in the distribution system—in the cables, buses, etc. Let us take, for instance, an average industrial plant typical of many now being built for war production. Let's assume that 13,200-volt power is brought to this plant and then stepped down to motor voltage, and that the total installed motor capacity is 10,000 hp., mostly in squirrel-cage motors. The plant is designed for 4000 kva. capacity, or 40 per cent load factor."

"Now," he continued, "an average 7½ to 10-hp. squirrel-cage motor requires not more than 2 to 3 lb. of copper per hp. Under the most ideal conditions—440-volt motors powered from a materials-saving load-center system where power is stepped down near the utilization area—up to 5 lb. of copper will probably be needed for each installed horsepower. If motors are selected 15 to 25 per cent too large then in addition to needless use of materials and facilities in motor manufacture, the amount of excess distribution copper is apt to be 7,500 to 12,500 lb."

Great variations in the ratio of the number of city employees to population are revealed by study of statistics resulting from state and local government employment surveys inaugurated about two years ago by the

(Continued on page 44)

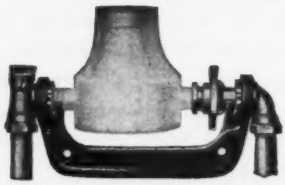
Serving Cities Everywhere



There are more Layne Wells and Pumps serving cities throughout the world than any other kind made. Layne Wells and Pumps are known as the most efficient ever built. They last longer and in upkeep cost have an amazingly fine record. They seldom need repairs of any nature. Write for latest catalogs, bulletins, folders, etc. No obligation. LAYNE & BOWLER, INC., Memphis, Tenn.

LAYNE WELLS & PUMPS

FORD YOKES



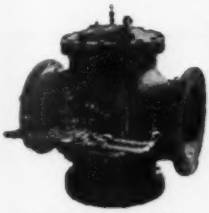
With the trend more strongly than ever toward greater accuracy and more frequent testing, the easy and trouble-free accessibility of a water meter set in a Ford Yoke makes this proven and perfected setting device most worth while.

Catalog sent for the asking.

FORD METER BOX CO., WABASH, IND.

1879—ROSS—1879

AUTOMATIC VALVES



ALTITUDE VALVE

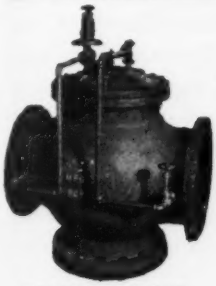
Controls elevation of water in tanks, basins and reservoirs

1. Single Acting
2. Double Acting

Maintains safe operating pressures for conduits, distribution and pump discharge



SURGE-RELIEF VALVE



REDUCING VALVE

Maintains desired discharge pressure regardless of change in rate of flow

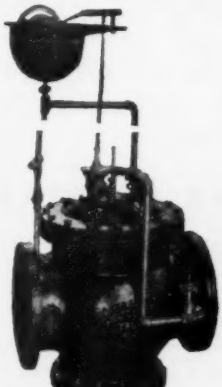
Regulates pressures in gravity and pump systems; between reservoirs and zones of different pressures, etc.

A self contained unit, with three or more automatic controls



COMBINATION VALVE

Combination automatic control both directions through the valve.

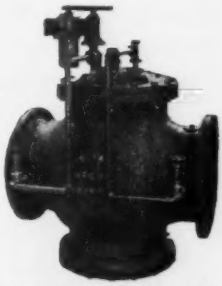


FLOAT VALVE

Maintains levels in tank, reservoir or basin

1. As direct acting
2. Pilot operated and with float traveling between two stops, for upper and lower limit of water elevation.

Electric remote control—solenoid or motor can be furnished



REMOTE CONTROL VALVE

Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

Packing Replacements for all Ross Valves Through Top of Valve

ROSS VALVE MFG. CO., INC., P. O. BOX 593, TROY, N. Y.

PREVENT WEAR AND CUTTING of rods, plungers and shafts by using



MABBS RAWHIDE PACKING

An Ideal Packing for Water Works and Sewage Pumps and Valves

MABBS HYDRAULIC PACKING COMPANY, *Inc. 1892*
431 S. Dearborn St., Chicago, Ill.

(*Continued from page 42*)

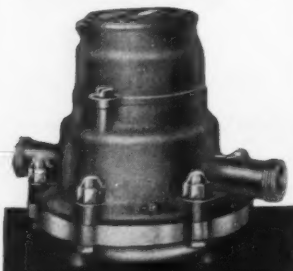
U.S. Bureau of the Census. The following interpretation is reprinted from "Citizen's Business" published by the Bureau of Municipal Research at Philadelphia.

"*The January 1942 Survey.* In its first quarterly survey for 1942, the Bureau of the Census presents, among other things, a list of all cities of the United States of over 5,000 inhabitants and the number of employes in each in January of this year, exclusive of those in schools, work relief, and contract work. The information is broken down into two broad classifications: (1) public-service enterprises, and (2) general governmental functions. The former includes water supply, electric light and power, municipal street railways, airports, and other muncipally operated public utilities. The latter includes all the other functions: general administrative and financial, legislative, judicial, police, fire, highways, sanitation and waste-removal, health, hospitals, charities (excluding persons on work relief), libraries, recreation and parks, and other general functions, including protective inspection.

"*Basis of Comparison.* Of these two classes, the latter, general governmental functions, affords the more significant basis of comparison. The table below accordingly shows, for each of the 14 cities of the United States having a population of more than 500,000, the number of employes engaged in general governmental functions and the number of such employes per 1,000 of population. It should be observed, however, that for 5 of these cities the figures include employes engaged in county functions as well as those engaged in city functions. These cities are Philadelphia,

(*Continued on page 46*)

NIAGARA IRON CASE WATER METERS



provide wartime copper conservation plus the time-proved Niagara design. They comply with victory-meter limitations. Works are interchangeable with American Bronze Case Meters.

WRITE FOR CATALOG.

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.



How Copper Helps to Fight the War

OUR COUNTRY'S war needs require all the copper and the copper-zinc alloy, brass, that would otherwise go into such familiar peacetime uses as service lines, rustproof plumbing, or automobile radiators.

Today, a major part of available copper and zinc is needed for ammunition—cartridge cases, rotating bands on shells, time fuses, etc.

Tremendous quantities of copper go into wire and cable for vital electrical conductors in the war industries—in tanks, and bombers, and battleships . . . still more copper is needed for a variety of other uses . . . in naval and merchant ships . . . in oil refineries, chemical plants, and the many other places where no satisfactory substitute exists.

These time-honored properties of copper . . . rust-immunity, corrosion-resistance, heat conductivity . . . and easy fabrication . . . are some of the important reasons why copper finds such great demand in our war program.

ANACONDA
from mine to consumer

4234B

Anaconda Copper

THE AMERICAN BRASS COMPANY, GENERAL OFFICES: WATERBURY, CONN.
Subsidiary of Anaconda Copper Mining Company

(*Continued from page 44*)

Baltimore, St. Louis, Washington, and San Francisco. Allowance for this fact should be made in comparing the figures for these cities with the other figures.

CITIES	POPULATION IN 1940	NUMBER OF EMPLOYES	EMPLOYES PER 1,000 OF POPULATION
1. Boston	770,816	12,075	15.67
2. Washington, D. C.	663,091	10,349*	15.61*
3. New York	7,454,995	100,626	13.50
4. Buffalo	575,901	7,399	12.85
5. Baltimore	859,100	10,624*	12.37*
6. St. Louis	816,048	9,758*	11.96*
7. San Francisco	634,536	7,291*	11.49*
8. Detroit	1,623,452	16,629	10.24
9. Milwaukee	587,472	6,007	10.23
10. Philadelphia	1,931,334	18,696*	9.68*
11. Cleveland	878,336	8,196	9.33
12. Chicago	3,396,808	27,807	8.19
13. Pittsburgh	671,659	5,180	7.71
14. Los Angeles	1,504,277	10,997	7.31

* Figures include employes engaged in county functions.

PERFECT WASH WATER DISTRIBUTION WITH WAGNER UNDERDRAINS



The patented design of concrete Wagner underdrain blocks assures perfect wash water distribution and equally efficient collection of filtered water.

Wash water discharges from protected orifices and its pressure is instantly dissipated against the filter floor. Any differences in pressure are immediately averaged. Thus, a uniformly gentle upward flow washes filters clean without carrying away sand.

Gravity filters equipped with Wagner underdrains have been tested by the nation's leading engineers and have been found to be more efficient than conventional types of filters.

Write for Bulletin 901-A for complete details.

INFILCO INCORPORATED

FORMERLY INTERNATIONAL FILTER CO.
325 W. 25TH PLACE, CHICAGO, ILL.

NEWS OF THE FIELD

Many of the water departments that are attempting to organize emergency civilian defense repair crews and auxiliary repair squads are finding themselves in difficulty due to the failure of some local civilian defense officers to understand the importance of water works repair men during a practice blackout or an actual air raid.

The Office of Civilian Defense has published and distributed to the larger water utilities throughout the United States a document entitled "Sanitary Engineering Bulletin No. 1—Protection and Maintenance of Public Water Supplies Under War Conditions." This bulletin stresses the necessity for water departments to organize emergency repair crews and at the same time emphasizes the propriety of complete recognition by the civilian defense leaders of water department functions and their critical relationship to air raid defense.

A problem that is developing at random over the country derives from the failure of the local defense executives to instruct their air raid wardens that water department emergency crews must move to sector centers at the time of an air raid alert. Likewise, air raid wardens appear not to have been sufficiently instructed concerning the magnitude of emergency work that would have to be done by a water department organization during and following an air raid attack. In several practice blackouts in one part of the country or another water works employees have been ordered to stand by at the time when they were moving to their regional sectors so that their participation in the training of the practice blackout has been practically nullified. This is highly unfortunate and distinctly not according to rules of the Office of Civilian Defense. In its bulletin "War Traffic Control," appears the following sentence:

"Routing plans must assure primarily that . . . traffic essential to civilian defense in the emergency is accommodated."

In the bulletin issued by the Office of Civilian Defense entitled "Traffic Control During Blackouts," special public utility service vehicles are listed in the "emergency vehicle group" entitled to move under blackout conditions. It is there requested that such vehicles be properly identified and that their movement under blackout conditions be restricted to emergency services. No one who has the public's interest at heart could object to those restrictions and it is certain that all water department men will recognize the propriety of these conditions under which their equipment should move either in practice blackouts or in actual air raids. But it is far more important that the local defense councils and the air raid wardens understand how vital the maintenance of public water supply is to the defense of, or the future existence of, a bombed community.

(Continued on page 2)

(*Continued from page 1*)

Many people recognize the fact that civil defense training activities are subject to the limitations that any training activity meets if the preliminary work does not move over into practice. This is particularly likely to be a difficult problem when so many people are engaged in voluntary work. But enough experience has been had in the training taking place all over the country to make it clearly evident that state water co-ordinators, state or regional association sections and water works executives need to make it plain, both firmly and politely, that no actual air raid will ever be endured by a community that does not let its water works repair crews and water works administrators get on the job when the air raid comes. This seems to be a pretty good time to get that idea into the minds of all persons concerned before any more mistakes—and serious ones—are made.

Lest we forget, the remarks of Wildsmith of Manchester, England, published in the February 1942 JOURNAL, are very much to the point in indicating the primary importance of recognition of the functions of the water department by the civilian defense officials:

"In Great Britain, the general A.R.P. Service, under the control of the town clerk, or other authority, establishes in each area a Central Control. At this center all reports concerning air raid incidents are received and sorted. Messages are sent in by police, air raid wardens, etc., reporting incidents on their patrols. *A representative of the water authority attends at the center, or the water authority maintains a control center for its own use,* and incidents concerning it are passed on from the Central Control. In many authorities the distribution section has been the 'Cinderella' of the service, but as heavy bombing is invariably on the cities and not on the outlying headworks, *the distribution staff becomes vitally important.* It follows therefore that its members should figure prominently in the control arrangements."

Wildsmith's entire article should be reread at this time.—HARRY E. JORDAN, *Secretary*, A.W.W.A.

(*Continued on page 4*)

Francis J. Arend, founder and President of the De Laval Steam Turbine Co., died on August 24 at the Fitkin Memorial Hospital, Neptune, N.J. He was also President of the De Laval Separator Co., which has grown from a small to a nation-wide organization during his association with it.

Mr. Arend was a director of the Marine Midland Trust Co. of New York, the Allenhurst, N.J., Bank & Trust Co., the Arex Indemnity Co. of New York, and the Fitkin Memorial Hospital. He was a member of numerous country clubs and the New York Athletic and Lawyers Clubs.



A MILE OF CAST IRON PIPE

SALVAGED and SOLD

FOR APPROXIMATELY ITS ORIGINAL COST

NEARLY forty years ago, at South Fork, Pa., about a mile of 8-inch pipe was installed to supply water to a coal mine. Last year the line was abandoned *but not the pipe*. This was *cast iron* pipe which can be salvaged or reused. It was dug up and salvaged for cash at a price approximately equal to its original cost—after nearly forty years of service. We have on file many records of old cast iron mains which have been taken up and re-used, or sold to other cities for re-use, or sold as scrap.

Pipe bearing this mark is cast iron pipe.

Available in diameters from 1¼ to 84 inches.

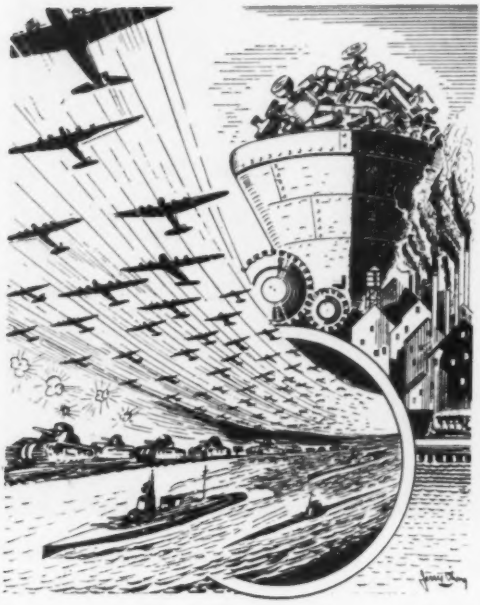
TRADE MARK REG.

CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER
1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)



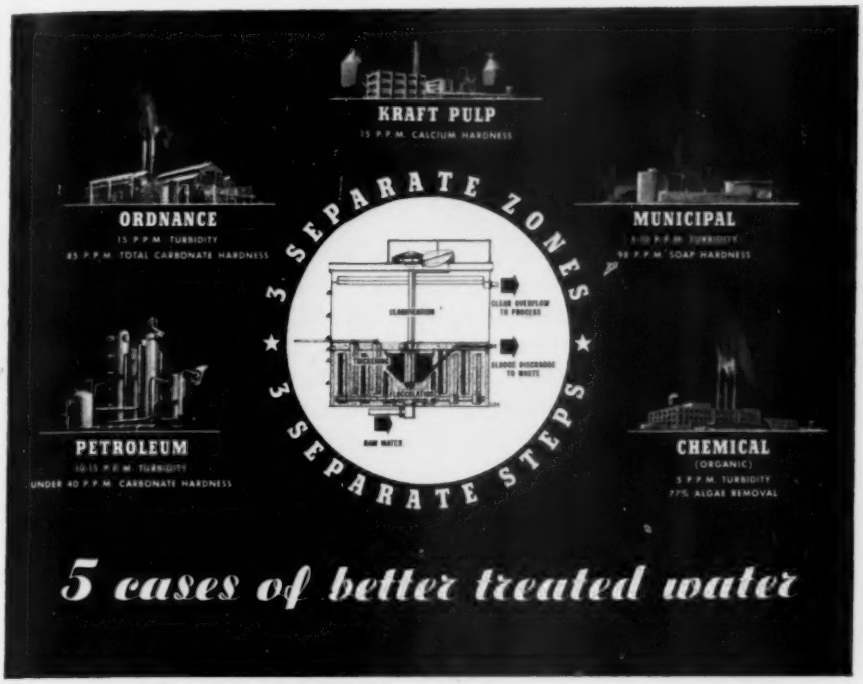
"Water Works Materials Go Into War Weapons," a graphic presentation with the fine cartoon shown at left, was recently sent to all consumers in Honolulu. The folder continues: "New Services Must Wait Until Victory—Every pound of copper, cast iron and steel is needed for war weapons. New water services for civilian purposes must wait. This is an order of the United States Government." This cartoon is reproduced through the courtesy of Frederick Ohrt, Manager, Honolulu Board of Water Supply.

(*Continued on page 6*)

William E. Clow, chairman of the Board, James B. Clow & Sons, died on September 14 at Chicago, nine days before his eighty-second birthday.

Mr. Clow had been active in the management of the company for the almost sixty-four years since he and his father formed the original partnership. Under his leadership, the company developed from a small pioneering firm in the plumbing and heating supply field to one of its largest jobbers as well as one of the largest manufacturers of cast-iron pipe.

William B. Connell, President of the Chemical Engineering Laboratories, Dallas, Tex., died on July 13 of a sudden heart attack. Mr. Connell was a native of Clarksville, Miss., and received his education at Oklahoma A. & M. College and the University of Missouri, receiving from the former the degree of Bachelor of Science and from the latter a Master of Arts. He had resided in Dallas since 1902 and was associated with the Chemical Engineering Laboratories for some time before he became President in 1927. He had been a member of the A.W.W.A. for the past twelve years.



THROUGH DORRCO HYDRO-TREATOR EFFICIENCY

★ The five instances above are good examples—but not the whole story by any means! Dorrco Hydro-Treators—thirty of them—are producing pure water to exacting specifications in nineteen plants throughout the country.

Many industries which have switched to war production are finding pure water to be an essential of production. Pulp for smokeless powder, high explosives manufacture, magnesium production and countless others demand an extremely pure water for use at some stage in their processing.

Dorrco Hydro-Treators meet these specifications by providing three separate zones for the three essential steps of Flocculation, Clarification and Thickening. A note to our nearest office will bring you a copy of our Hydro-Treator leaflet giving details of operation.

The DORR COMPANY Inc.
ENGINEERS · 570 LEXINGTON AVE. · NEW YORK
ATLANTA TORONTO CHICAGO DENVER LOS ANGELES

(*Continued from page 4*)

The critically short supply of copper was accented recently by the announcement that the U.S. Treasury Dept. had decided to release 40,000 tons of silver for use by the electrical industry. When copper is being released for war purposes by such measures, water works men will realize the need for turning in all possible scrap and for doing without copper in water works operation.

Silver is used chiefly for power plant bus-bars but is also very useful for joints and connections in electrical conductors. E. P. Bryant, writing in the Los Angeles Department of Water and Power publication, *Intake*, for August 1942, cites a great many instances of the indispensable use of silver in the Boulder power plant. He considers the release of the 40,000 tons a step in the right direction. With domestic silver price-pegged at $1.29 per ounce and not enough imported silver arriving at the foreign silver price of 35 cents per ounce, he feels that more of our vast store of silver should be released. The amount we have is indicated by the estimate that the Treasury Dept. has on hand about 100,000 tons to back up its silver certificates now in use.

A.W.W.A. membership dues are exempt from federal income taxes according to a ruling of the Commissioner of Internal Revenue, because the A.W.W.A. is organized solely for educational purposes. Members who pay A.W.W.A. dues from their own personal funds may deduct this payment in computing their personal income taxes.

The Office of Civilian Defense has released a new set of simulated war gases for teaching the identification of their odors. The glass containers and corrugated paper case use a minimum of strategic materials and supplant a more expensive outfit. The simulated gases, which imitate the odors of mustard gas, phosgene gas, chlorpicrin, Lewisite and tear gas, are guaranteed for a period of not less than four months with normal use, provided the bottles are kept tightly closed when not in use. Each bottle

(*Continued on page 8*)

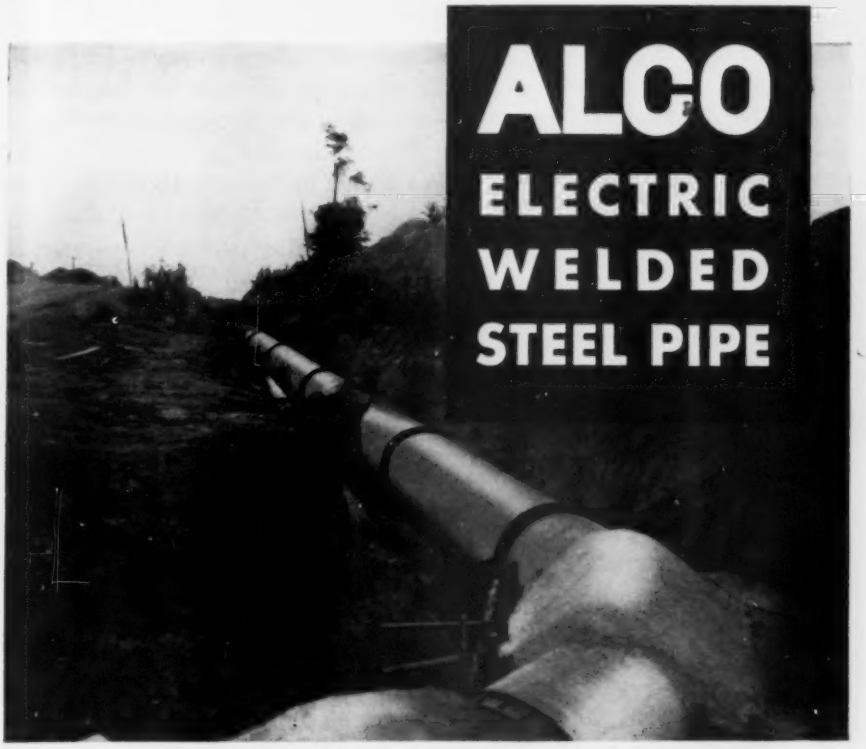
NIAGARA IRON CASE WATER METERS



provide wartime copper conservation plus the time-proved Niagara design. They comply with victory-meter limitations. Works are interchangeable with American Bronze Case Meters.

WRITE FOR CATALOG.

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.



Alco electric welded steel pipe fabricated in accordance with the latest improved methods is highly resistant to sudden shock and rupture. Alco pipe is low in initial cost and designed for long life.

BUY ALCO
AND AVOID EXPENSIVE REPAIRS

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(*Continued from page 6*)

is labeled with the name of the simulated gas, the army symbol for it, and a memory aid for easy identification. The contents of the bottles are harmless and therefore require no special precautions in handling or shipment.

Anyone may order these kits for training purposes from the Northam Warren Corp., Stamford, Conn., at a cost of $1.25 each, prepaid. Replacements of the individual bottles are $.25, prepaid to any point in the U.S.A.

"Act now—this is your War" is what Boyd A. Bennett, President of the Northeastern Water & Electric Service Corp., says to the plant operators of that concern. His concrete suggestions are quoted:

"Fewer loose words and more action is a good formula for fighting the War on the home front. Let's leave the Congressmen out of our conversation for a while, and get right down to doing something demonstratively active where we are. Let's talk at home.

"We have prepared for catastrophe and disasters, the bombings that may come—the saboteurs—the casualties. We have taken first aid courses and perfected ourselves in duties of air wardens—all needed and important. But there are more constructive jobs at home that need to be done and that have been overlooked. Tiresome jobs and unromantic enough, but vital in the all-out effort we are making to stop a grimly vicious enemy.

"We can talk shop to customers. That talk can be more talk about leaks, but this time we are talking for Uncle Sam and not just to save something on water bills, so perhaps they will hear you; perhaps the message will ring a bell and they will do something about it. Explain to them, as you meet them, as they talk to you over the counter while paying bills, why new extensions are taboo and why Mrs. Brown must do without a new service line until after the war. Tell them how it is that materials used in water mains and services, meters and faucets, are vital materials for building the war machines that will protect them from something infinitely worse than a little personal inconvenience. This is the kind of talking to do, the sort that has action behind it!"

And under the title, "The Little Foxes," Mr. Bennett made this appeal. These ideas may be very helpful in your own publicity.

"One of the little foxes that we have to watch out for is *Leaks*. We have droned on for years and years about leaky faucets and faucets left

(*Continued on page 10*)

PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

Trade Mark MABBS Reg. U. S. Pat. Off.

MABBS RAWHIDE PACKING

An Ideal Packing for Water Works and Sewage Pumps and Valves

MABBS HYDRAULIC PACKING COMPANY, *Inc. 1892*

431 S. Dearborn St., Chicago, Ill.

Hersey Announces

the new Rust Resistant Iron Cas Water Meter with the "Magni-Vision all glass Bonnet

Magnifying feature Patented June 4, 1907, by a Hersey employee

A circular giving full information will be mailed upon request



HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES

(*Continued from page 8*)

running and the overflowing bathtub. We have told the customer plenty about his bad habits. When he complained about high bills we reminded him pleasantly that the cost of a washer would stop a bad leak in both his faucet and his water bill. Leaks! Leaks! Stop the Leaks! That has been our slogan, our fetish, our frown upon our brow.

"What about our own leaks? The War has brought us face to face with our own diagnoses and it's up to us to swallow our own medicine. What about leaks in the distribution system? Leaks in the reservoir? Leaks in services? Leaks at joints? What about dripping nozzles of fire hydrants and hydrant branches? These are the *leaks* that we can stop, right on our own home ground.

"This is one of the items of waste that is a contributory cause to more pumping, to more wear and tear on equipment, and ultimate breakdowns that require new equipment or new parts. To save materials vital to the Nation's war production, materials for planes, tanks, guns and ships, think of saving in terms of revolutions of motors, in terms of the needless use of everything in the system. These are the little foxes that spoil the vines. One of our jobs is to stop waste of all kinds right on our doorstep."

(*Continued on page 12*)

Serving Cities Everywhere



There are more Layne Wells and Pumps serving cities throughout the world than any other kind made. Layne Wells and Pumps are known as the most efficient ever built. They last longer and in upkeep cost have an amazingly fine record. They seldom need repairs of any nature. Write for latest catalogs, bulletins, folders, etc. No obligation. LAYNE & BOWLER, INC., Memphis, Tenn.

LAYNE WELLS & PUMPS

IRONCRETE



IRONCRETE Meter Boxes consist of an oval iron top with a round lid having a Lifter Worm Lock, and a concrete body which you can cast yourself by means of a handy form. Durable, convenient, inexpensive,—made in two sizes. Write for catalog

FORD METER BOX CO., WABASH, IND.

A BRIGHTER FUTURE FOR YOUR CITY

—in soft, clear, iron-free water



HAPPIER HOMES!

Soft, clear water means less work, more fun



BUSIER INDUSTRIES!

Less treatment for boiler and process water

MORE PROSPEROUS SHOPS!

Better Service—at less cost—for laundries, restaurants, etc.



Plan now for a better water supply

After the war, when public improvements are resumed, a good water supply will be the first thought of many communities. Take the first step toward this modern necessity *now*. Write for free booklet to The Permutit Company, Dept. G2, 330 West 42nd Street, New York, N. Y.

In Canada: Permutit Company of Canada, Ltd. Montreal . . . Toronto . . . Winnipeg . . . Calgary

* Trademark Reg. U. S. Pat. Off.

Permutit* Spaulding Precipitator

Here's a new type of equipment that puts soft water within reach of every community. It makes cold lime soda treatment more practical than ever before, because it takes only half the space of old-type plants, cuts precipitation time, makes big savings in chemicals.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

(*Continued from page 10*)

By reductions of water waste, Philadelphia's water works have been enabled to meet, thus far, the increased demands created by the war. While waste has not yet been cut to a minimum, and efforts to reduce it must continue, the water conservation campaign has introduced waste-prevention measures of permanent value in the operation of the city's water supply system.

Greater Use; Smaller Output. It is obvious, although definite figures are not available, that industries working day and night at top speed to produce war materials are using more water than they needed in peacetime. Moreover, the many thousands of war workers who have come to the city have further increased the use of water. Largely through the reduction of waste, these added demands upon the water works have been met with less water than was supplied during the same periods of last year. In May 1941 the average daily output of the water works was, in round figures, 325,000,000 gal.; in May 1942 it was 307,000,000 gal. The average daily output in June 1941 was 331,000,000 gal.; in June 1942 it was 308,000,000 gal. A marked increase occurred in July 1942, but the daily average was only 319,000,000 gal. whereas in July 1941 it was 335,000,000 gal.

Leakage Stopped. Surveys to locate and stop leakage from the water distribution system have eliminated much waste. These surveys have covered only West and South Philadelphia, but on August 1 the losses computed for these sections totaled 11,062,000 gpd. Losses recorded but not yet computed will probably add between 500,000 and 750,000 gpd. to the total. Leaks are stopped as soon as they are discovered. Furthermore, considerable leakage has been stopped by the repair and renewal of hydrants and the repair of valves. From March 18, 1940 to July 25, 1942, 1,429 hydrants were renewed and 6,803 were repaired; from June 30, 1941 to July 31, 1942, 2,699 valves were repaired. Also, the increase in waste of water which occurs when the pressure is needlessly high has been curtailed by the adjustment of valves.

Consumer Waste. As the reduction of 16,000,000 to 23,000,000 gpd. in the output of the water works exceeds by 3,000,000 to 10,000,000 gal. the leakage of not over 13,000,000 gpd. thus far eliminated from the distribution system, it is apparent that the consumers must be helping by reducing waste in buildings. However, the total of 50,000,000 gpd. which

(*Continued on page 14*)

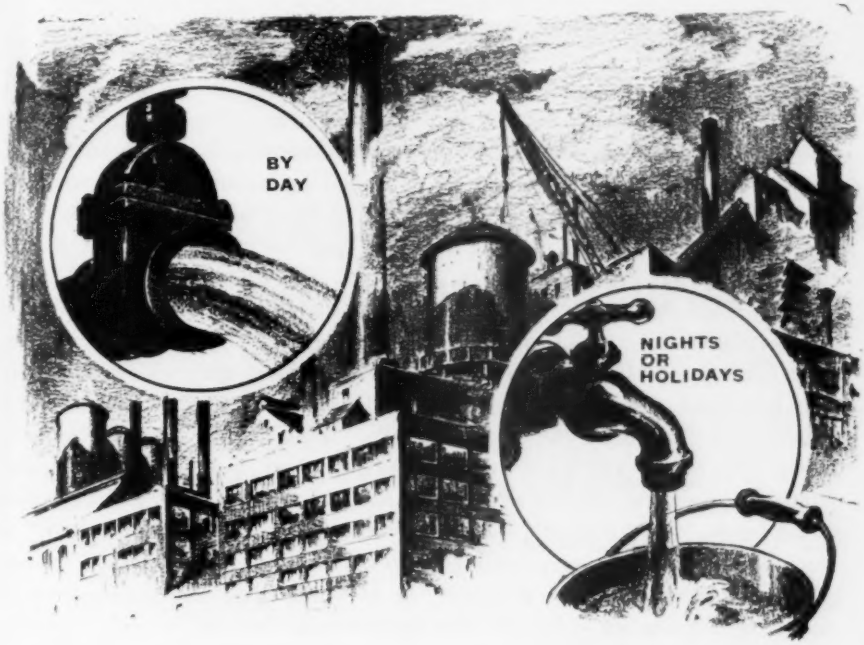
COOK Well Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

A. D. COOK, INC.

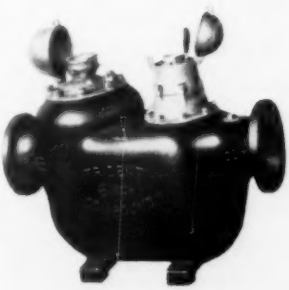
Lawrenceburg - Indiana

COOK Deep-Well Turbine Pumps



Measure with ACCURACY over the entire range of flow

TRIDENT
COMPOUND METER



WHERE industrial plants use large quantities of water part of the day, and are entirely or partially shut down for certain other periods, the Trident Compound Meter fits exactly into the picture as a means of accurately measuring the volume of water delivered, irrespective of the rate of flow, during the entire twenty-four hours.

NEPTUNE METER COMPANY • 50 West 50th Street • NEW YORK CITY

Branch Offices in CHICAGO, SAN FRANCISCO, LOS ANGELES, PORTLAND, ORE., DENVER, DALLAS, KANSAS CITY, LOUISVILLE, ATLANTA, BOSTON.

NEPTUNE METERS, LTD., LONG BRANCH, ONTARIO, CANADA

29

(*Continued from page 12*)

surveys found was being wasted by consumers in the years 1926–1931 indicates that much waste still remains which could be stopped by the consumers. More than half of Philadelphia's consumers lack the incentive to conserve water which would be provided by metering their services. In Detroit, where over 99 per cent of the services are metered, the daily per capita consumption in 1941 was 133 gal.; in Philadelphia it is still close to 150 gal.

To Hold the Gains. The measures which are enabling the water works to meet the wartime demands are also desirable in peacetime. Other large cities—for example, New York, Chicago, and Detroit—continually search for and stop leaks in their water distribution systems, and thereby lighten the burden on their water works. Philadelphia's present survey is the first since 1931; in the intervening years wastage accumulated. Routine inspection and repair of hydrants and valves is also good practice at all times. As for waste of water by consumers, the best preventive is universal metering, a step which is probably impossible during the war. All water services should, however, be metered when peace comes. But metering alone is not sufficient; the meters must be kept in repair. Tests

(*Continued on page 16*)



STRONG -TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere

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Main Sales Office: 50 Church Street, New York, N. Y.
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HYDRO-TITE

Reg. U. S. Pat. Off.

A Symbol of Quality

A DEPENDABLE SELF - CAULKING JOINT COMPOUND



WORTHINGTON

EQUIPMENT FOR WATER SUPPLY

CENTRIFUGAL PUMPS	STEAM AND POWER PUMPS
TURBINE WELL PUMPS	SUMP AND DRAINAGE PUMPS
DIESEL ENGINES	GAS ENGINES
STEAM CONDENSERS	CONDENSER AUXILIARIES
FEEDWATER HEATERS	STEAM-JET EJECTORS
STATIONARY COMPRESSORS	PORTABLE COMPRESSORS
ROCK DRILLING EQUIPMENT	CONSTRUCTION AIR TOOLS
MULTI-V-BELT DRIVES	AIR LIFTS
MOORE STEAM TURBINES	SPEED CHANGE GEARS

●

WATER PURIFICATION EQUIPMENT
Water Softeners Pressure Filters

●

WATER METERS

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

WORTHINGTON PUMP AND MACHINERY CORPORATION
WORTHINGTON-GAMON METER COMPANY
General Offices: HARRISON, NEW JERSEY *District Offices and Representatives in Principal Cities*

IC1-21

(*Continued from page 14*)

of meters four inches and over in size made during the present surveys have disclosed that some meters had stopped entirely and that others were under-registering by considerable percentages.

The above is from *Citizen's Business* for August 25, 1942.

Richard Hazen, formerly Associate Engineer with Malcolm Pirnie, has been commissioned Lieutenant, J.G., U.S.N.R., and is now serving at the U.S. Naval Training Station, Sampson, N.Y.

Henry J. Miles, formerly Assistant Professor of Civil Engineering at the University of Florida, is now at the College of Engineering, University of Southern California, as Associate Professor of Civil Engineering.

Robert F. Coleman, who in 1941–42 was Instructor in Materials Testing under the ESMDT Program at North Carolina State College, has been commissioned an Ensign, U.S.N.R., has been on active duty as Officer Trainee to observe ship construction, and is scheduled to attend the M.I.T. Naval Architectural School this fall.

(*Continued on page 18*)

3 *Money, Time and Labor Saving Features of*

UNIVERSAL CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.



For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

Dept. C
THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

NAME_____

STREET_____

CITY_____



COLD WEATHER COMING

Main laying in temperatures from Zero to 36° below may be tough with some jointing compounds, but not with *Tegul*-MINERALEAD • At the thermometer's other extreme, *Tegul*-MINERALEAD is probably the only practical compound used in pipes carrying hot water • And, lest you forget, *Tegul*-MINERALEAD comes in 10 lb. ingots, easy to handle, store and ship, impervious to moisture and proof against change in composition • Yes, *Tegul*-MINERALEAD is available, stocked at convenient points over the U. S. • For further information, address The ATLAS MINERAL PRODUCTS Company of Penna., Mertztown, Pa.

Tegul MINERALEAD

for Jointing Bell & Spigot Main

BARRETT ENAMEL—FOR COMPLETE UNDERGROUND PROTECTION



Owen River Aqueduct, Los Angeles Department of Water and Power. Barrett Enamel.

FIELD SERVICE—The Barrett Waterworks Service Department and staff of Field Service men stand ready to provide a broad measure of cooperation. These services include consultation on technical details, training of crew, and job inspection.

Barrett WATERWORKS ENAMEL

● Inexpensive and easy to apply, Barrett Waterworks Enamel provides uniform, nonconducting coating that forms a hard, mirror-like finish to give an exceptionally high coefficient of flow.

Barrett Enamel meets the standard specifications of the American Water Works Association. It is dielectric, water-tight, and resistant to corrosion and to mechanical distortion. Made from the most stable bituminous material known for underground pipe protection, it maintains capacity at the peak and keeps yearly upkeep costs at a gratifying minimum.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK

(*Continued from page 16*)

L. C. Billings, for the past 12 years Superintendent and Chief Chemist of the Dallas, Tex., Water Purification Plant, was recently appointed Superintendent and Chief Chemist of both water purification and sewage treatment. This is another example of the pronounced trend to unified supervision of "new and used water" cited by Wendell R. LaDue in his paper on water works management in the text of this JOURNAL.

Linné C. Larson, Junior Mechanical Engineer for the Los Angeles Department of Water Power, has entered military service as Captain in the U.S. Engineers and is stationed at Los Angeles.

Homer W. Jorgenson is now on leave of absence from his duties as Assistant Sanitary Engineer of the Bureau of Sanitary Engineering, California State Health Dept. He is now serving as Associate Sanitary Engineer at the Los Angeles District Office of the U.S. Engineer Dept. His previous work was special investigation of winery and cannery waste, cross-connections, and beach and stream pollution. His new work is also concerned with plant design, but with the accent on planning temporary plants and using a minimum of critical materials and mechanical equipment.

(*Continued on page 20*)

SAVE FOR DEFENSE

EVERYWHERE Americans are being asked to "SAVE FOR DEFENSE." Water works superintendents, engineers and public officials can do more in this connection by investigating the National Method of water main cleaning. This method restores the carrying capacity of pipe to at least 95 per cent of that of new mains, thereby eliminating the necessity for purchase of new mains. Aside from this the National Method makes possible lower pumping costs, greater delivery, reduced insurance rates and clean water.

Now is the time to do your part—SAVE FOR DEFENSE

National Water Main Cleaning Co.

30 Church St., New York, N. Y.

BRANCHES

115 Peterboro St., Boston, Mass.
910 William Oliver Bldg., Atlanta, Ga.
7103 Dale Ave., St. Louis, Mo.
406 Florida Theatre Bldg., Jacksonville, Fla.
3812 Castellar St., Omaha, Neb.
205 West Wacker Drive, Chicago, Ill.
501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Canada



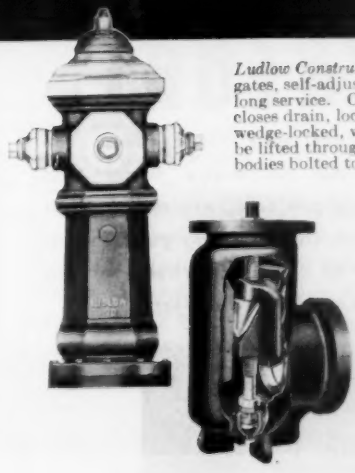
Except "every man in service"



When and if such announcements are made over our radios, "every man in service" will have very special significance. Then, the hours of extra effort and weeks of special training by city fire departments will prove their worth.

Also proving their worth will be the army of Ludlow Hydrants—then "in service" as never before. Ludlow Hydrants are always ready for action, prepared to deliver a steady flow of water, instantly and with minimum shock. They operate on the famous slide gate principle, which provides smooth action of free moving parts and assures long, trouble-free service. If damaged in a blackout collision or otherwise, the Ludlow Hydrant will not flood, because it is wedge-locked when closed. These, and other superior construction features, make them ideal for that new defense area in your city! Send for Catalog. .

THE LUDLOW VALVE MFG. CO., INC.
TROY, NEW YORK



Ludlow Construction. Self-releasing 30° angle wedges and free-floating gates, self-adjusting to seats, afford smooth, trouble-free performance, long service. Opening and closing of hydrant automatically opens and closes drain, located at lowest point. Clogging is prevented. Gate is wedge-locked, when closed, to prevent flooding. All working parts may be lifted through top of hydrant for easy inspection. Top and bottom bodies bolted together at ground line.

LUDLOW HYDRANTS

SINCE 1866

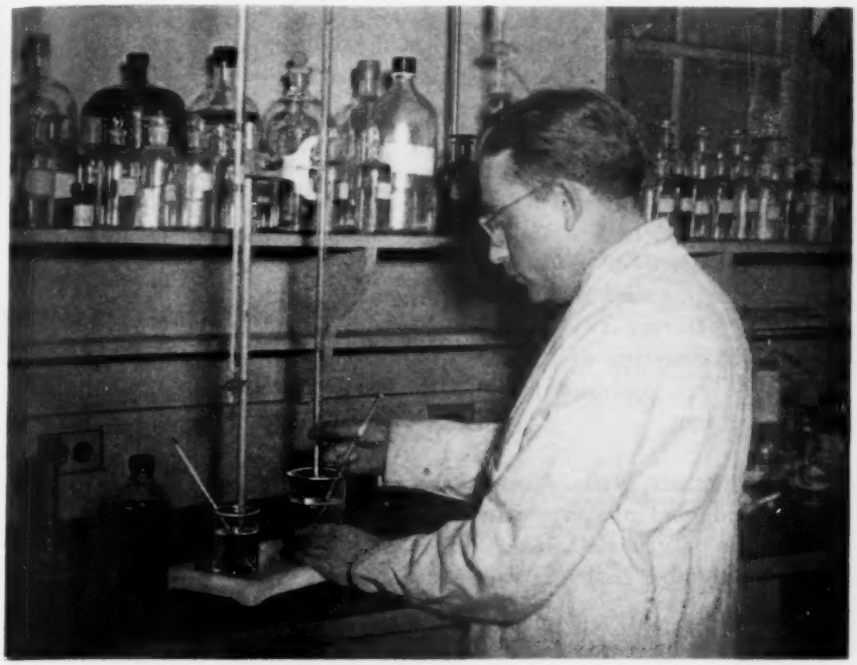
(*Continued from page 18*)

William T. Ingram, from 1935 to 1941 Sanitary Engineer of the San Joaquin Health District, Stockton, Calif., and on leave of absence from that position in 1941–42 to attend the Johns Hopkins School of Hygiene and Public Health, has been granted further leave of absence to permit him to accept a commission as Passed Assistant Sanitary Engineer, Reserve, U.S. Public Health Service. He has been assigned to the Ninth Regional Office of Civilian Defense, to serve as assistant to G. E. Arnold, Regional Sanitary Engineer, with the duty of assisting in the co-ordination of protective measures in the entire sanitation field. He was Chairman of the A.W.W.A. California Section in 1941 and has been an active member in this and numerous other professional organizations.

H. H. Gerstein, for the past 17 years Sanitary Engineer in charge of the Water Safety Control Section of Chicago's Bureau of Engineering, has joined the U.S. Army Sanitary Corps. He is temporarily stationed at Camp Grant, Ill., Co. C, 32nd Medical Training Battalion. T. Schmid Jr., formerly assistant to Mr. Gerstein, has taken over the latter's duties at Chicago.

(*Continued on page 22*)





Overdosage no problem with Ozone

The removal of taste and odor from water with ozone presents no overdosage problem. It is simplicity itself, calling for a minimum of check testing.

Ozone, which in practice is air-borne activated oxygen, adds no objectionable taste-producing ingredient to the water in any dosage.

An overdosage, due perhaps to a constantly changing water, disappears without trace within a few minutes of injection, because excess ozone is relatively insoluble in water. On the other hand, though an underdosage of ozone may partially reduce the taste and odor, it certainly does not increase them.

The simplicity of ozone control saves, rather than adds, time and labor.

And the end result is a more palatable water at a surprisingly low additional cost. At Whiting, Indiana, it is $1.41 per m. g.

Send for your copy of our Bulletin No. 104 and Supplement. It will bring you up to date on the largest ozone installation for water purification in the United States.

Ozone Processes
INCORPORATED

1500 Walnut Street
PHILADELPHIA

A WHOLLY OWNED SUBSIDIARY OF WELSBACH ENGINEERING AND MANAGEMENT CORPORATION.

(*Continued from page 20*)

Arthur O. Tomek, formerly Sanitary Engineer, City of Two Rivers, Wis., is now serving as Sanitary Engineer, Water, Sewer and Service Unit, War Dept. Office of Chief of Engineers, Washington, D.C.

Herbert E. Hudson Jr., until recently engaged on design and specification work for Chicago's South District Filtration Plant, has been granted a leave of absence by Chicago's Dept. of Public Works, and is now located at 912 West Charles St., Champaign, Ill., from which address he will continue to carry on with the duties of Secretary of the Illinois Section of the A.W.W.A. During 1940–41 Mr. Hudson also served as Instructor in Sanitary Engineering at Armour College of Engineering and from 1931 to 1941 he was Assistant to John R. Baylis at Chicago's Experimental Filtration Plant.

W. Plummer Wells, Chemist for the Aberdeen, S.D., Water Dept., has been inducted into service and is now Private, Company H, 2nd Chemical Warfare Service Battalion, Camp Sibert, Gadsden, Ala. He has been an Active Member of the A.W.W.A. for the past three years.

(*Continued on page 30—Membership Listings pages 26–29*)

EDSON
DIAPHRAGM PUMPS

Hand Operated--sizes 2", 2½", 3", 4"
Power Operated--sizes 3" and 4"

Open Discharge or Force Pump
Skid, Truck or Trailer Mounted

COMPLETE PUMP OUTFITS
Edson Pumps - Suction Hose
Brass Couplings - Bronze Clamps
Red Seal Diaphragms
Brass Strainer or Foot Valve
Hose Spanners - Adapters - Etc.

Also—Brass Hydrant Pumps

THE EDSON CORPORATION
Main Office and Works: 49 D St., South Boston, Mass.
New York, 142 Ashland Pl., Brooklyn

FOR
Quick Repairs in DEFENSE Emergencies!



For wartime emergency-breaks in pipe lines, this Doublex Simplex Split Sleeve will enable you to make quick, economical, effective repairs. You should have a supply of several of each different size that you might need. Thousands in use, some for 13 years. Order now from shipping point nearest you as follows: Birmingham, Dallas, Kansas City, Los Angeles, Minneapolis, San Francisco, Pittsburgh.

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM, ALA.
New York City Chicago Los Angeles San Francisco
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Water Supply, Water Purification, Sewerage, Sewage Treatment, Flood Control, Drainage, Refuse Disposal

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Water Supply, Treatment, Sewerage, Reports, Plans, Estimates, Supervision and Operation Valuation and Rates.

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Water, Sewage, Garbage, Industrial Wastes, Valuations.—Laboratories

Leader Bldg. CLEVELAND — **Woolworth Bldg. NEW YORK**

THE PITOMETER COMPANY

Engineers

Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Penstock Gaugings

50 Church St. — **New York City**

MORRIS KNOWLES, INC.

Engineers

Water Supply and Purification
Sewerage and Sewage Disposal,
Industrial Wastes, Valuations,
Laboratory, City Planning.

Park Building — **Pittsburgh, Pa.**

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Sewerage—Sewage Treatment
Water Works—Industrial Wastes
Flood Control—Fire Protection
Advisory Service, Reports and Designs

Baltimore Life Building BALTIMORE, MD.

METCALF & EDDY

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NEWSOM & ALDRICH

Engineer-Consultants

Water Supply, Purification and Distribution
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Valuations and Reports

500 Fifth Ave. New York — **Harrisburg, Pa. Williamsburg, Va.**

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WESTON & SAMPSON

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Changes in Membership

NEW MEMBERS

Applications Received August 1 to 31, 1942

★ *denotes military service*

Azpurua Q., Pedro P., Civ. Engr., Direccion de Obras Hidraulicas y Sanitarias, Este 8, No. 123, Caracas, Venezuela (July '42)

Bailey, Albion A., Filtration Engr., Bureau of Water Supply, Montebello Filters, Baltimore, Md. (July '42)

Baldwin, Boone, City Mgr., Paris, Tenn. (July '42)

Berlin Water Co., Phil. A. Shaffer, Mgr., 615 Main St., Berlin, Pa. (Corp. M. July '42)

Blakeley, Loren E., Regional Water Works Advisor, State Dept. of Health, 703 State Bldg., Los Angeles, Calif. (July '42)

Blalock, William W., Jr., Jr. Chemist, Fort Bragg Water Works, Box 5, Manchester, N.C. (July '42)

Campbell, Ralph A., Water Dept. Acct., 161 Civic Center Bldg., San Diego, Calif. (July '42)

Duff, William, Supt. of Filtration, Box 178, Malartic, Que., Can. (July '42)

Ecorse, City of, Leland R. Gare, City Engr., City Hall, Ecorse, Mich. (Corp. M. July '42)

Edwards, S. Everett, Chemist, Bureau of Water Supply, 1313 Crofton Rd., Baltimore, Md. (July '42)

Evans, Daniel William, Reg. San. Engr., U.S. Public Health Service, Office of Civilian Defense, 968 Plymouth Rd., N.E., Atlanta, Ga. (July '42)

Gare, Leland R., *see* Ecorse, City of

Glenn, J. L., Supt. of Maint. & Utilities Dept., Fraser-Brace Engineering Co., Inc., Keystone Ordnance Works, Meadville, Pa. (July '42)

Harrington, W. L., Supt., Mayfield Elec. & Water Systems, 215 E. Broadway, Mayfield, Ky. (July '42)

Jenkins, Joseph Edwin, Student Civ. Engr., 106 E. 20th St., Austin, Tex. (Jr. M. July '42)

Leahey, Edward F., Supt. of Elec. Constr., Bureau of Water Works & Supply, 410 Ducommun St., Los Angeles, Calif. (July '42)

Leonard, Hobart, Supt., The Virginia City Water Co., Virginia City, Nev. (July '42)

Meinzer, Oscar E., Chief, Ground Water Div., U.S. Geological Survey, Washington, D.C. (July '42)

Mylis, Geo. W., Supt. of Public Works, Tawas City Water Dept., 222 Second Ave., Tawas City, Mich. (Affil. July '42)

Neal, F. E., Supt., Rancho Mutual Water Co., Rolling Hills, Calif. (July '42)

Schimberg, E. A., Jr. Engr., Johns-Manville Sales Corp., 116 New Montgomery St., San Francisco, Calif. (Oct. '42)

Shaffer, Phil. A., *see* Berlin Water Co.

Shaler, Richard G., Mgr., California Div., Calgon, Inc., 149 California St., San Francisco, Calif. (July '42)

Starkey, Fred, Chief Engr., Caro State Hospital, R.R. 2, Caro, Mich. (Affil. July '42)

Stephens, George William, Jr., Chief Engr. Baltimore County Metropolitan Dist., Jennifer Bldg., Towson, Md. (July '42)

Van Norman, D. M., Supt. of Equip., Bureau of Water Works & Supply, 444 Ducommun St., Los Angeles, Calif. (July '42)

Wamsley, Robert, Supt. of Water Plant, Climax Molybdenum Co., Climax, Colo. (July '42)

Wheeden, H. Ford, Office Engr., Baltimore County Metropolitan Dist., 1525 E. 28th St., Baltimore, Md. (July '42)

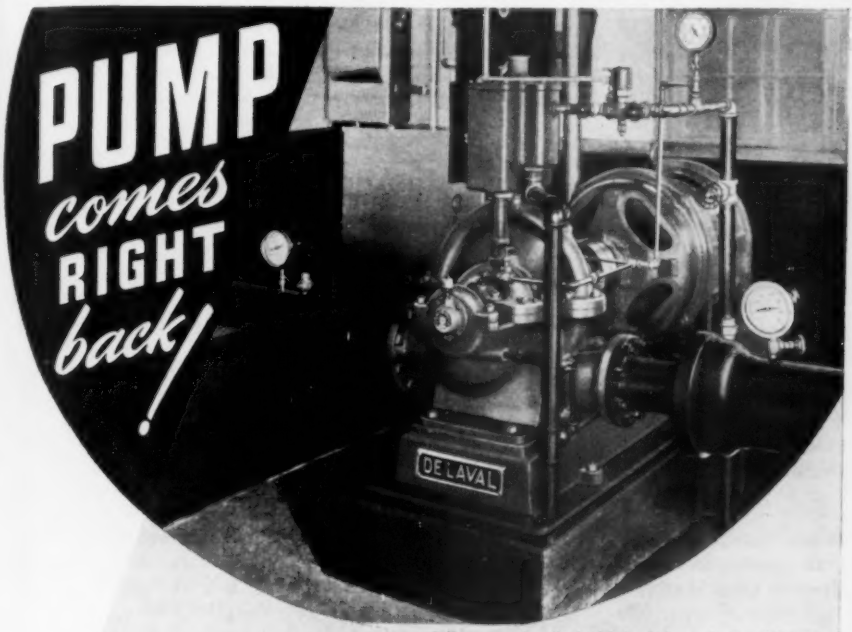
REINSTATEMENTS

Browning, C. R., Cons. Engr., The Irvine Co., Tustin, Orange County, Calif. (Nov. '32)

Bugher, S. B., Supt., Water Dept., Reidsville, N.C. (Jan. '30)

Sleeper, William H., Combustion Engineering Corp., 200 Madison Ave., New York, N.Y. (May '23)

(*Continued on page 28*)



Pump fitted with De Laval submerged suction priming system; 1100 g. p. m. against 245 ft. at 1750 r. p. m.

If the three-quarter-inch corporation cock on the suction pipe of the pump illustrated above is opened wide, delivery of water ceases, but is resumed again within one minute after the cock is closed, the pump being at once reprimed by the

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LOSSES

Resignations

Schettler, Haydn A., Dist. Engr., Power Products & Ind. Dept., Johns-Manville Sales Corp., 116 New Montgomery St., San Francisco, Calif. (Oct. '41)

Deaths

Olson, Pehr, Jr. Engr., Los Angeles Bureau of Water Works & Supply, 14429 Hatteras St., Van Nuys, Calif. (Jan. '35)

Thiessen, Frank C., Cons. Engr., Public Service Com., Madison, Wis. (Oct. '24)

Changes in Address

Changes of address between August 15 and September 15, 1942

Allen, G. P., *see* Santa Ana Valley Irrigation Co.

Cochrane, John C., 78 Lincoln Rd., Snyder, Williamsville, N.Y. (July '35)

Cornell, Chas. Brown, % Buckeye Lake Yacht Club, Buckeye Lake, Ohio (May '28)

Cowan, Walter G., *see* Ruberoid Co.

Duhme, R. E., 5911 Red Bank Rd., Box 29-C, R.R. No. 10, Cincinnati, Ohio (Oct. '38)

Franz, Edwin F., 2419 Napoleon Blvd., Louisville, Ky. (Oct. '39)

Fresno City Water Dept., Claude H. Weekes, Supt., 2326 Fresno St., Box 512, Fresno, Calif. (Corp. M. Jan. '32)

Fulkman, John A., 102 N. Hamilton, Madison, Wis. (July '28)

Gibbons, Mortimer M., Box 162, Rahway, N.J. (Nov. '22)

Heffelfinger, Donald D., Supervising Chemist, Alliance City Water Works, 560 W. Oxford St., Alliance, Ohio (July '41)

Hetzer, Hugh W., Western Div., Pomona Pump Co., 2621 Locust St., St. Louis, Mo. (July '35)

Hills, Robert C., 180 E. 79th St., New York, N.Y. (Jan. '41)

Hudson, Herbert E., Jr., 912 W. Charles St., Champaign, Ill. (May '33)

Ingram, Wiliam T., Ninth Regional Office of Civilian Defense, 1355 Market St., San Francisco, Calif. (July '35)

Kipp, W. H., 947 S.E. Market St., Portland, Ore. (Apr. '40)

Langton, Bernard B., 107 W. College St., Longview, Tex. (Oct. '41)

Leonard, James M., Pres., The Virginia City Water Co., Virginia City, Nev. (May '30)

Loveland, Chester H., Cons. Engr., 300 Montgomery St., San Francisco, Calif. (Oct. '24)

Matthews, J. C., 909 Architects & Builders Bldg., Indianapolis, Ind. (Jan. '38)

Miles, Henry J., Assoc. Prof. of Civ. Eng., College of Eng., Univ. of Southern California, Los Angeles, Calif. (July '41)

Milford, T. H., Bureau of Sanitation, State Health Dept., Montgomery, Ala. (Apr. '38)

Miracle, Ralph, Elk River Cement Products Co., Billings, Mont. (Apr. '40)

Morrison, H. H., 517 Hamilton Bank Bldg., Chattanooga, Tenn. (July '35)

Murdoch, William J., San. Engr., 3984 Drexel Rd., Pittsburgh, Pa. (Jan. '36)

Newton, Harry E., The Spring Water Co., Kane, Pa. (Oct. '40)

Olson, W. M., Supt. of Filtration, 1806 Elmwood Ave., Wilmette, Ill. (Apr. '26)

Parkhurst, E. R., Asst. Sales Mgr., Rensselaer Valve Co., Troy, N.Y. (July '40)

Peirson, Nat. D., Box 47, Raleigh, N.C. (Jan. '40)

Rice, P. J., Water Works Supervisor, Camp Butner, Durham, N.C. (Oct. '39)

Rickard, Grover E., 130 East St., Oneonta, N.Y. (June '26)

Ruberoid Co., The, Walter G. Cowan, Mgr., Eastern Div., 500 Fifth Ave., New York, N.Y. (Assoc. M. Apr. '41)

Santa Ana Valley Irrigation Co., G. P. Allen, Secy.-Treas., 154 N. Glassell St., Orange, Calif. (Corp. M. Apr. '38)

Thane, H. S., Valley Water Co., Hamilton, Mont. (Apr. '26)

Tomek, Arthur O., San. Engr., 926—17th St., S., Arlington, Va. (Oct. '35)

Towne, W. W., 1530 Rydalmount Rd., Cleveland Heights, Ohio (Dec. '29)

Weekes, Claude H., *see* Fresno City Water Dept.

Wilmarth, Albert, Chem. Engr. 4827 Lake Park Ave., Chicago, Ill. (Oct. '40)

MEMBERS ENTERING MILITARY SERVICE

Eaton, Thomas J., Supt., Bureau of Water, Amsterdam, N.Y. (July '35)★

Finley, Lester, Gen. Foreman, California Oregon Power Co., 1103 Upham St., Klamath Falls, Ore. (Jan. '41)★

Gerstein, H. H., 6826 Clyde Ave., Chicago, Ill. (Dec. '25)★

Hazen, Richard, Assoc. Engr. with Malcolm Pirnie, 25 W. 43rd St., New York, N.Y. (July '37)★

Hopkin, W. Howard, Field Repr., Self Liquidating Div., Reconstruction Finance Corp., Lincoln Bank Bldg., Louisville, Ky. (Jan. '40)★

Kleber, J. P., Eng. Service, Calgon, Inc., 300 Ross St., Box 1346, Pittsburgh, Pa. (July '41)★

Knoener, Chas. J., Field Engr., The Pitometer Co., 50 Church St., New York, N.Y. (July '40)★

Larson, Linné C., 3425 Amesbury Rd., Los Angeles, Calif. (Apr. '36)★

McAdam, S. Allen, City Engr., 369 N. 9th St., Lebanon, Pa. (Apr. '36)★

Paulus, Harold J., Asst. San. Engr., Box 811, Lamarque, Tex. (July '41)★

Stanley, William E., 1735 N. Troy St., 414 Colonial Village, Arlington, Va. (Nov. '20)★

Watkins, William W., Supt., Water Dept., 130 East St., Oneonta, N.Y. (June '22)★

Wells, W. Plummer, Chemist, Aberdeen Water Dept., 1402 N. Lincoln St., Aberdeen, S.D. (July '39)★

Wood, James, Eng. Inspector of Water Works, 215 Walnut St., Peekskill, N.Y. (Apr. '37)★

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★ BRANCHES IN PRINCIPAL CITIES ★

(*Continued from page 22*)

G. Gale Dixon, who has recently served as Chief Sanitary Engineer for Caribbean Architect-Engineer, in the design of water supply and sewerage facilities for the Army bases in the southern Caribbean area, is now associated with Parsons, Klapp, Brinckerhoff & Douglas, Engineers, New York, N.Y. For the past several years, Mr. Dixon has been engaged on numerous water supply and flood control projects and previously, from 1932 to 1935 he was engaged in private practice as Consulting Engineer with headquarters at Youngstown, Ohio. He has also served as Deputy Chief Engineer of Ohio's Mahoning Valley Sanitary District and at Akron, Ohio, where in six of his ten years there, he was Chief Engineer of the Bureau of Water Works Improvement.

Hugh W. Hetzer, formerly Engineer for the West Virginia Water Service Co. at Charleston, W.Va., is now Sales Engineer, Westco Div., Pomona Pump Co., St. Louis, Mo. He has charge of condensation, boiler feed and centrifugal pump units. Until joining Pomona Pump, he was with the West Virginia Water Service Co. continuously since being graduated from Carnegie Institute of Technology in 1936.

(*Continued on page 32*)

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Water Crane
Type



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Non-Rising Stem—Outside Screw and Yoke—Hub End—Flanged End—Ends to Fit any Type Pipe.

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Requires less than 0.5 cc. sample.
Accuracy ± 0.1 pH.
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(*Continued from page 30*)

Charles Brown Cornell has resigned from his duties in connection with the construction of the Savage River Dam for the Upper Potomac River Commission. There has been a disagreement and no settled policy for proceeding with the project under a WPA arrangement and under existing emergency conditions. Mr. Cornell served for the past two years as Assistant Superintendent for this project being built to increase the dry weather flow of the Potomac. An Active Member of the A.W.W.A. since 1928, Mr. Cornell has been previously engaged on the Prettyboy Dam and Reservoir at Baltimore, the Mineral Ridge Dam and Reservoir of the Mahoning Valley Sanitary District, the O'Shaughnessy Dam and Reservoir at Columbus, Ohio, the Rockwell Dam at Akron, Ohio, and on numerous water, sewerage and sewage disposal plants.

Grover E. Rickard resigned as of September 15 his position as Engineer in charge of filtration at the Burlington, Vt., water works, to accept an appointment as Acting Superintendent of Water Works and Sewage Treatment at Oneonta, N.Y. His predecessor, William W. Watkins, resigned to take up a commission as Captain, U.S. Army Sanitary Corps.

J. P. Kleber, Sales Engineer with Calgon, Inc., Pittsburgh, Pa., has been called to active duty with the U.S. Army Air Force. Lt. Kleber is a graduate of Texas A. & M. and was Chief Chemist of the Water Purification Plant, Dallas, Texas, before joining the staff of Calgon, Inc.

H. S. Thane, Superintendent of the Missoula Division of the Montana Power Co., Missoula, Mont., has resigned that position and moved to Hamilton, Mont. He has purchased the water systems at Hamilton and Plains, Mont. Harry McCann is the new Superintendent at Missoula.

Thomas J. Eaton, Superintendent of the Amsterdam, N.Y., Bureau of Water, has left that position and on September 15 reported for active duty as a Captain at Carlisle Barracks, Pa.

(*Continued on page 34*)

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DALLAS, 1229 PRAETORIAN BUILDING • SAN FRANCISCO, 631 RIALTO BUILDING

SEATTLE, 1132 EIGHTH AVENUE, SOUTH

(*Continued from page 32*)

R. W. Haywood Jr. has left the position of Chemist for the Chester, Pa., Municipal Authority Filter Plant and is now Water Supervisor for the United States Rubber Co. at Williamsport, Pa.

Harold B. Gotaas, formerly Professor of Sanitary Engineering in the School of Public Health, University of North Carolina, has been commissioned Captain in the Sanitary Corps and is serving as Chief of the Engineering Section of the Division of Health and Sanitation in the Office of the Co-ordinator of Inter-American Affairs, Washington, D.C.

Information to assist the home owner in fuel conservation methods, the procedure of converting oil burner heating plants to coal, and the proper methods of firing coal and other fuels in heating equipment are outlined in a new pamphlet entitled "War on Fuel Waste—How To Do It" just issued by the War Service Committee of the American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York, N.Y. Copies may be obtained at $8.00 per 1,000 or upon individual request when accompanied by a self-addressed return envelope, or five cents in stamps to cover addressing and mailing.

(*Continued on page 36*)

CUMULATIVE INDEX TO THE JOURNAL AND PROCEEDINGS

1881–1939 Inclusive

The Cumulative Index to the Journal and Proceedings of the American Water Works Association is ready for its place on your shelves, where it will render your bound volumes of these publications far more useful for ready reference. After this edition was printed the type was torn down, and future indexes will commence with the issue of January, 1940. Get your copy *now*. Price to members, $1.75; to members for cash with order, $1.50; to non-members, $2.00. Write to—

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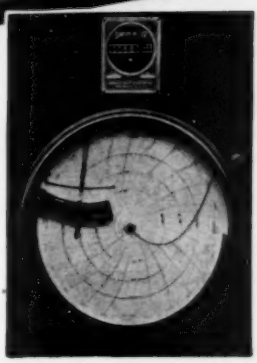
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(Continued from page 34)

Buffalo, N.Y., has raised its water rates from 10 to 11 cents per 100 cu.ft. for the first 3,000 cu.ft. per month by action of the Common Council. The new rates, which went into effect September 1, supplanted rates which had been charged since September 1920.

Other changes are: from 3,000 to 6,000 cu.ft., from 7 to 7.7 cents per 100 cu.ft.; and over 6,000 cu.ft. from 4 to 4.4 cents per 100 cu.ft. All asylums, churches, public hospitals, charitable institutions, schools (public, private and parochial) and colleges had their rates raised from 3 cents per 100 cu.ft. for all water used, whatever the quantity, to 3.3 cents.

Toronto's water rates cannot be changed because of the Canadian Wartime Prices and Trade Board regulations according to Toronto's Controller R. H. Saunders and City Solicitor C. M. Colquhoun, quoted in *Engineering and Contract Record* for September 2, 1942. Toronto wishes to remove some inequalities in its rate structures, raising some rates and lowering others. Controller Saunders has, however, warned against a general lowering of rates predicated upon increased wartime revenue. Revenue for January 1 to July 31 in 1940 was $2,227,079, and for the same period in 1942, $2,396,605.

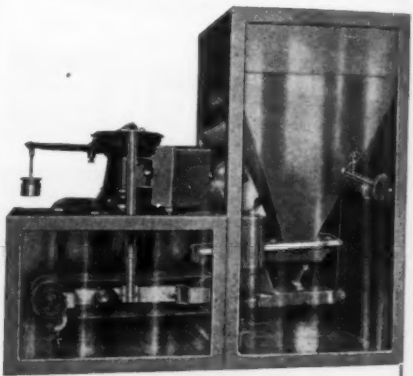
(Continued on page 38)

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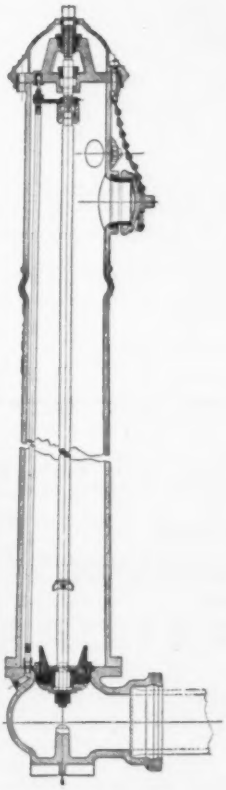
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eliminates all guess work—and feeds exactly the right amount—by weight

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Adequate water supply for camps, air ports, munition plants, industrial housing and fire protection has become a matter of national concern, so we must be on the alert. In these dangerous days, as in the last war, *SMITH* valves and hydrants are being called upon for added service by the government and private concerns. They have proven their worth as among the most effective weapons for water works preparedness.

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Smith Tapping Machines—Tapping Sleeves and Valves—O'Brien Hydrants—Valve-Inserting Machines—Removable Plugs, Pipe Cutting Machines—Corporation Tapping Machines—Gas Tee-Inserting Machines—Corporation Cocks—Federal Water Meters

(*Continued from page 36*)

Despite a 1,000,000-gal. increase in daily consumption of water in New Haven, the engineers of the New Haven Water Co. report that the total water storage is now 359,000,000 gal. greater than in August 1941. A survey of the available water supplies shows that in mid-August the 18 reservoirs of the Company contained 7,555,000,000 gal., or 76 per cent of usable storage capacity. A year previously the reservoir storage was at 72 per cent of capacity and last January at only 62 per cent.

"Fire Tests of Building Construction and Materials" and "Fire Tests of Door Assemblies" are two new standard methods adopted by the National Fire Protection Association's Board of Directors in May 1942. These have now been approved by the American Standards Association and are now available in combined pamphlet form from N.F.P.A. at Batterymarch St., Boston, Mass.

"Sabotage and Its Prevention" by Dorothy Campbell Tompkins is War Bibliography No. 1 issued by the Bureau of Public Administration, University of California, Berkeley, Calif. It is a 24-page pamphlet and costs 35 cents per copy.

(*Continued on page 40*)

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GLASS STANDARDS

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COMPARATORS



You do not need to make your own standards, or wonder whether prepared standards have faded, if you use HELLIGE Glass Color Standards, which are *perpetually guaranteed against fading.* For their long life and reliability they have been the choice of hundreds of water plants.

HELLIGE Comparators, in combination with these standards, are enjoying an increasing popularity because of their durability, compactness and efficiency.

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A steam shovel, excavating for new bridge foundations, struck and broke an important main in the water supply of a New York village. The main was buried in the bed of a stream which carried sewage from many village homes. This sewage, washing in and around the break at this low point in the lines, meant a serious threat to public health.

But the waterworks engineer was well prepared to meet such an emergency. His first thought was Per*chloro*n—a quick, dependable means of sanitizing the water supply and safeguarding the health of his fellow townspeople.

Sleeves were applied to the broken main to reduce sewage infiltration and partially restore the water pressure. Taps were made on both sides of the break, and Per*chloro*n was pumped into the main through each tap. Within a few minutes, 3 ppm residual chlorine was detected in nearby domestic water services. This residual was maintained during the five days required to replace the broken pipe.

No B Coli were found in the system as a result of this break. The engineer says, "We give a good deal of credit to Per*chloro*n for our clean record during this emergency."

Waterworks engineers in every section of the country have found Per*chloro*n a dependable standby for just such emergencies because of its quick solubility, greater stability and high chlorine content—more than 70% available chlorine. They use it also for sanitizing small water systems, new mains, wells and swimming pools.

At present, Per*chloro*n is, of course, being used to meet urgent war time demands, and we ask our customers to cooperate with us by ordering only for immediate needs, *well in advance* . . . To help you solve some of today's unusual problems, there is a nearby Penn Salt representative who is at your service without obligation. And if you do not have your *free* copy of our illustrated booklet on Per*chloro*n, with valuable data on water purification and sewage treatment, write today to Dept. JA.

Perchloron
REG. U.S. PAT. OFF.



PENNSYLVANIA SALT MANUFACTURING COMPANY
Chemicals
1000 WIDENER BUILDING, PHILADELPHIA
NEW YORK • CHICAGO • ST. LOUIS • PITTSBURGH • WYANDOTTE • TACOMA



(*Continued from page 38*)

Homes built in 310 leading American cities in 1941 reached the highest value and volume in 12 years, according to E. E. Crabb, President of the Investors Syndicate, who has made public the results of that concern's seventh annual national housing survey. Dwelling units in these 310 cities are estimated to total 14,869,245, as of January 1, 1942. Of this total, 9.1 per cent, or 1,356,787 units were 11 years or less old. Homes constructed last year in these cities housed 990,264 people. This was 4.6 per cent greater than those housed by units built in 1940.

"Code of Minimum Requirements for Instruction of Welding Operators, Part A—Arch Welding of Steel $\frac{3}{16}$ to $\frac{3}{4}$ in. Thick" is a revision of the "proposed code" which was issued by the Welding Society in 1941 and given wide circulation. The latter was adopted and reprinted by WPB for use in defining an "accredited school." The material has been considerably expanded, particularly with respect to supplementary material suggested by persons organizing classes. This Code is a 68-page booklet with heavy paper cover, and is available at 50 cents per copy from the American Welding Society, 33 West 39th St., New York, N.Y.

(*Continued on page 42*)



SAVE MONEY USE ACTIVATED ALUM and BLACKALUM

STUART-BRUMLEY CORP.
516 North Charles St.
Baltimore Maryland

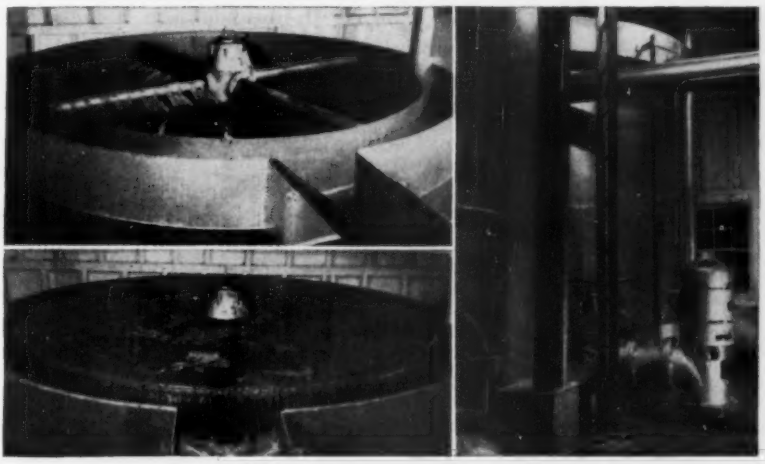
M H

HIGH QUALITY VALVES HYDRANTS

M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.

"American"
FERROFILTER PLANTS

Iron Removal Now Made Economical



Ferrofilter Units at Hartford City, Indiana

FERROFILTERS:-

Remove CO_2 and H_2S.

Oxidize and filter out Iron and Manganese in the same unit.

Do not require subsequent sand filters or chemicals.

Are Backwashable. Runs between backwashing average 2 days—Backwash period 1 minute with a 15 inch rise.

Are more economical to build and simpler to run than any other form of Iron Removal.



(*Continued from page 40*)

The Builders Iron Foundry, Providence, R.I., was awarded on August 24 the Army-Navy "E" pennant for excellence in production of war equipment, including Venturi meters and control equipment for camps, forts and bases. Employees and officers of Builders Iron Foundry were greeted as "fellow soldiers" by an Army officer during the celebration.

Two-stage centrifugal pumps of the opposed impeller design are described in a 12-page catalog issued by the De Laval Steam Turbine Co., Trenton, N.J. In this type of pump both impellers are of the single-suction type, the suction openings facing outwardly, so that axial thrust is balanced. Only two pairs of wearing rings are required. The casing is so arranged that both the suction and discharge nozzles are in the lower half, and all parts of the pump are accessible and can be removed upon removing the casing cover. This type of pump is listed for capacities from 50 to 1,500 gpm., and for heads from 80 to 800 ft.

Two-way emergency radio equipment recently demonstrated its worth on a large war construction project on the California coast where electric pumps were being employed to keep ocean water below the level of excavation. A crane on the job accidentally struck a power line, cutting off the power to the pumps. The Southern California Edison Co. two-way General Electric radio system immediately went into operation and dispatched the nearest service truck to the broken line. Power was back on the pumps in 36 min., about half the time that would otherwise have been required.

Heavy duty cast-steel butterfly valves are described in detail in a 4-page bulletin, No. 15-B, recently made available by R-S Products Corp., Wayne Junction, Philadelphia, Pa. These valves have face-to-face dimensions sufficient to permit the mounting of ball bearings for high pressure service.

(*Continued on page 44*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

ZEOLITE CHEMICAL CO.
90 WEST STREET NEW YORK, N. Y.

CONSULTING ENGINEERS

In changing times, and we all are aware that these are changing times, Consulting and Sanitary Engineers must constantly place their names and services before those in the Sewerage and Sewage Treatment fields who need such counsel. An excellent way of directing attention to your services is to place a professional card in the DIRECTORY OF ENGINEERS of each issue of SEWAGE WORKS JOURNAL.

SEWAGE WORKS JOURNAL is the official publication of the Federation of Sewage Works Associations; and, is the leader in its field. Its highly specialized circulation of over 3,000 and low advertising rates assure effectiveness plus economy.

The cost of a twelfth page professional card is only $48.00 per year, payable $8.00 bimonthly.

For information write to

ARTHUR A. CLAY
ADVERTISING MANAGER
40 Wall Street
New York, N. Y.



LABOR—skilled or unskilled is a serious problem.

Avoidable pipe line repair work should have your FIRST consideration.

HILL-HUBBELL Steel Pipe protection, backed by years of service, has by its excellent performance, proven its worth as a low maintenance cost product.

★ **Write TODAY for THE BOOK OF PIPE PROTECTION which describes our process in detail.** ★

TQA-1



SPECIFICATION TQA-1 MEETS A.W.W.A.A. 67

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. - Division - Cleveland, Ohio
EXPORT OFFICE - SAN FRANCISCO, CALIFORNIA, U. S. A.

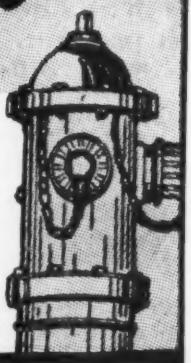
(*Continued from page 42*)

"Wood Pipe" is Catalog 19 recently published by the Federal Pipe and Tank Co. It is a 336-page book with leatherette cover, containing 47 tables, countless photographs and diagrams, and an 8-page index. The subject is covered under four headings: (1) Descriptive and General Information, (2) Specifications and Construction Details, (3) Flow Tables and Other Data and (4) List Prices. The catalog is available from the Federal Pipe and Tank Co., 6851 East Marginal Way, Seattle, Wash.

The Foxboro Company, Foxboro, Mass., has just issued a complete catalog of its instruments for the measurement and control of industrial process conditions. The 48 pages comprise ten sections, six of them grouping and describing all the instruments, accessories and supplies appropriate to a particular field of application, such as Temperature, Flow, Pressure, Level, Humidity; while the remaining sections cover combination instruments, valves, instrument panels and similar subjects. The catalog, thoroughly cross-indexed, with an ingenious use of colors, has over 200 illustrations. It may be obtained by writing the Foxboro Company for Catalog 95-A.

LEARN ABOUT FIRE HYDRANTS

Now



Now is the time to get full specifications of the Kupferle line. A more than fifty year record of unequaled, unfailing performance.

JOHN C. KUPFERLE FOUNDRY CO., ST. LOUIS

KUPFERLE FIRE HYDRANTS

"STOP"

says

RUSTA RESTOR TRADE MARK REGISTERED

PATENTED PATS. PEND.

to

RUST IN STEEL TANKS

Rusta Restor is the positive method of preventing rust in all types of steel tanks and riser pipes (the electrical method)

RUSTA RESTOR CORP.

1440 W. State Street

FREMONT OHIO

NEWS OF THE FIELD

P-46 Amended: The Amended form of Order P-46, given in the text pages of this issue of the JOURNAL, is of prime importance. It allows new high ratings—AA-5 for the routine purchase of repair materials, and the very high rating of AA-2X for emergency purchases.

But with these new privileges, water works men are faced with the duty of reducing their inventories *as well as their use* of repair and maintenance material.

First—there are no new or additional restrictions placed upon the stores and use of material needed to keep up production equipment and structures. This means that wells, supply lines, pumps, filters, chlorinators—everything that it takes to put water into the mains—can be kept in as first class order for service as was the recorded practice in 1940. The 1940 recorded use of materials as well as inventory thereof has been considered by the Power Branch to be a fair yardstick to measure the normal needs of the field.

If system output has increased, paragraphs (f) (4) (i) and (ii) authorize proportionate increases in purchase of maintenance materials for *production* and *pumping* facilities.

But second—distribution maintenance *stores* and *use* must be cut 40 per cent below 1940 levels. There are many good reasons for this. They cannot be discussed here but simply must be accepted in loyal American spirit.

Third—only 60 per cent of this can be bought from manufacturers. The rest must be obtained from surplus stocks of other water plants. This includes pipe, valves, specials, hydrants, meters, etc. The inventory records on meters must be kept separate from the other distribution materials records. The purchase of meters must be considered by itself and held to the 60 per cent level of inventory as well as the further 60 per cent purchase limitation—altogether apart from the other distribution materials. Paragraph (f) (4) (iii) allows the purchase of meters needed to serve the net increase in customers in any quarter year. It means this—suppose that a plant, in 1940, had a distribution repair inventory of $5,000. Now only $3,000 worth of similar material can be kept in stores and $2,000 worth must be set aside as surplus, for sale or trade with other water works that need it. When the allowable inventory total gets below $3,000, purchases can be made from manufacturers *up to $1,800 worth only.* The $1,200 worth balance must be bought or borrowed from the neighboring water works, or from a plant's own surplus if it contains the items that are needed. Remember these figures are used only as an example. Apply them to your own plant and own figures.

(Continued on page 2)

(*Continued from page 1*)

When it comes to using from the *distribution* stock pile, where $100 worth was used before, only $60 worth can be used now. Some things simply cannot be done. Stick to essentials and let the frills wait.

Mutual aid must go to work now. Every water works man in every state must work with—and for—his own state water co-ordinator (or whatever he is called). Give him your surplus inventory list and buckle down to make things work and service go on. After six months or so, the surplus will all be used up—and the critical shortage of metals eased up. Right now our task is to work and share with our neighbor water works and keep water flowing!

Some confusion exists in localities where the 1940 records are incomplete or where the 1940 conditions were abnormal. As an indicator of what may be considered to be a *reasonable 1940* inventory, the WPB records (on Form 193B) of the plants serving over 50,000 persons have been studied—195 of these plants serve 36,500,000-plus persons of the probable 83,500,000 persons now having public water supply available.

The figures which follow are expressed upon the basis of "*per 1,000 persons served*" and can thus be compared with any city by a simple multiplication process.

	INVENTORY, 1940	USE PER QUARTER, 1940	APPROXIMATE USE/CAPACITY OF INVENTORY
Total	$387.39	161.83	7 months
Fuel	15.48	31.32	45 days
Chemicals	15.07	19.09	60 days
Production	15.94	8.84	6 months
Distribution:			
Pipe, Values, Hydrants, Etc.	286.15	78.81	11 months
Meters	37.50	12.97	9 months
Other Materials & Supplies	17.25	10.79	5 months

These figures indicate that the inventory position of the larger cities will stand restriction without endangering service—if Mutual Aid is made effective. Fuel and water treatment chemicals are not restricted by P-46 (see paragraph (f) (6)). Upon the basis of these figures the *average* plant must reduce its inventory of pipe, valves, etc., from $286.15 to $171.69 per 1,000 persons. When re-stocking is necessary, it can buy only $103.02 worth of that from manufacturers, and $68.67 worth must be obtained from the surplus at other water plants. Likewise, the *average* meter inventory would have to be reduced from $37.50 to $22.50 and only $12.50 of that can be spent with the manufacturer. These are average figures—for illustration only—and do not mean that a plant has a *right* to these amounts. A plant's 1940 pattern governs.

(*Continued on page 4*)



SALVAGED AND RE-USED
because it's CAST IRON PIPE...

TO INCREASE the supply of water required by a nearby war plant, as well as the growing needs of the community, Hellertown, Pa., had to replace about a mile of 10″ cast iron pipe with a 16″ cast iron line. The old line, after 44 years of satisfactory service, was found to be sound and serviceable, and was re-laid elsewhere to serve out its century or more of useful life.

It is impossible to foretell future requirements or population shifts but any public official can be sure that, when water or sewer mains must be abandoned, re-routed or enlarged, the pipe can be salvaged or re-used, if it is cast iron pipe.

Pipe bearing this mark is cast iron pipe.

Available in diameters from 1¼ to 84 inches.

TRADE MARK REG.

CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER
1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

CAST IRON PIPE
PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

Two important interpretations have just been received:

(1) Pending orders for maintenance and repair material may be rerated at levels conferred by the new P-46—if the customer executes *Rerating Certificate* (Form PD-4Y). Rerating can be applied to an order *only* so far as the revised inventory/use restrictions of P-46 affect the right of the customer to order materials for delivery from a manufacturer. It may be preferable for a customer to file a new order.

(2) Projects of the P-200, P-19, P-545 categories are not re-ratable under the terms of the new P-46 Order and materials held in stores for any such projects (incomplete) are not to be taken into account in computing the dollar value of the maintenance and repair inventory. If or when a special project is complete, any materials remaining on hand become subject to the inventory restrictions of P-46.—HARRY E. JORDAN, *Secretary, A.W.W.A.*

A "dormant" scrap collection drive was started on October 1, by the War Production Board Conservation Branch. "Dormant scrap is defined as obsolete machinery, tools, equipment, dies, jigs, fixtures, which are incapable of current or future use in the war production effort because they are broken, worn-out, irreparable, dismantled or in need of unavailable parts necessary to practical re-employment. *Dormant scrap should not be construed to apply to re-usable machinery, equipment, dies, jigs, or fixtures, which can currently or in the future be used by the owner or others, with or without repairs, in work which contributes directly to the war production effort.*" Water works executives are advised to co-operate fully in the collection of scrap metals from which no further service can be obtained *but* not to include in their scrap collections any machinery, tools, pumps, motors, or other water works equipment from which further service can be had if repairs are made. It is especially important that State Water Co-ordinators be promptly advised if pumps, motors, etc., have been taken out of service and can be made available to some other water works having need for units of the size and/or capacity of the retired units. If such material is at hand in any water plant, the co-ordinator should be given precise information concerning the size, type, make, etc., of the available equipment, so that it can be properly catalogued.

Utilities seeking rate increases will soon be advised by the OPA on the character of notice and information which all utilities or common carriers must file before rate increases may be permitted.

WPB Copper Branch regulations require early ordering. To insure delivery of copper products at the time when the material is required, it is necessary that purchase orders be placed at least 60 days before the requirement date and, whenever possible, 90 days advance placement is

(*Continued on page 6*)

Stop bacteria in mains



DRY BRAIDED FIBREX

FIBREX is a paper packing treated with a special water repellent which keeps it sterile and prevents its disintegration. It has a hard twisted core with a basket weave covering. Fibrex packs in a joint exactly the same as braided jute.

FIBREX is put up in 35 and 60 pound reels. It is priced slightly higher than braided jute but is much less expensive as 70 pounds of Fibrex will go as far as 100 pounds of jute.

FIBREX is being used with Hydro-Tite and other self-caulking compounds, with lead, Sani-Tite and other asphalt sewer joint compounds. Thousands of pounds of Fibrex are in service in both water and sewer joints throughout the country.



USED LIKE BRAIDED JUTE

•

WILL NOT BREED BACTERIA

HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 CHURCH STREET, New York, N. Y.
Works: WEST MEDFORD STATION, Boston, Mass.

(*Continued from page 4*)

recommended. The procedure now required by the Copper Branch in reporting and shipping orders, as given in a bulletin published by the Copperweld Steel Co., is as follows:

"(1) Assuming that your purchase order reaches us on any October date, the material becomes shippable in December after the following requirements have been met:

"(2) Your order would be listed on our report to the Copper Branch at the end of October which individually lists all of the orders on our books up to and including the last day of October. This report must show the exact material which you have ordered, along with the preference rating and the production code or end use symbol shown on your purchase order.

"(3) Our report of orders on hand for the month of October is analyzed by the Copper Branch and we receive specific authorization to ship certain orders. This authorization for December shipment, received during the latter half of November, may include all of the orders on our report or only part of them. The orders not authorized cannot be shipped.

"(4) About December first the required amount of copper is allocated to us for manufacturing the orders which we have been authorized to ship, and shipment of the orders may be completed during December. Orders

(*Continued on page 8*)

DIFCO

Presumptive and Confirmatory Media for Detection of Coliform Bacteria

This group of Dehydrated Culture Media, Difco, is prepared expressly for the detection and confirmation of coliform bacteria in water. Each medium conforms to the requirements of "Standard Methods of Water Analysis" of APHA-AWWA in ingredients, formula and reaction. Results obtained by the use of these standardized media are reliable and comparable.

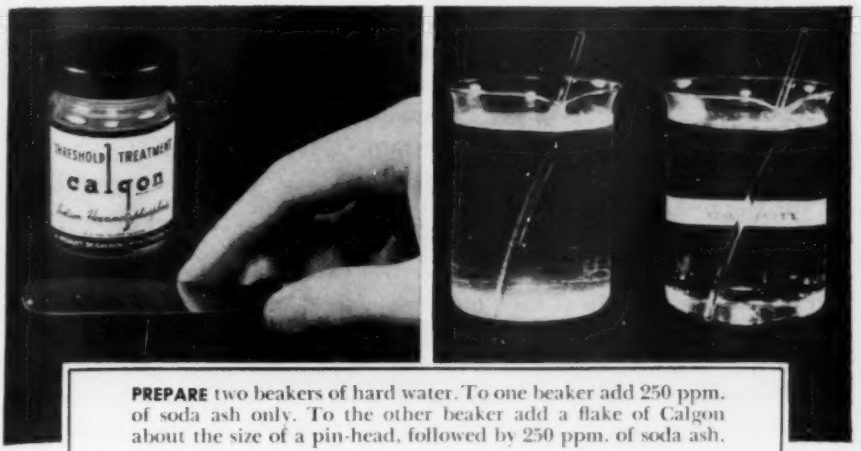
Bacto-Lactose Broth
Bacto-Brilliant Green Bile 2%
Bacto-Crystal Violet Lactose Broth
Bacto-Formate Ricinoleate Broth
Bacto-Fuchsin Lactose Broth
Bacto-Endo Agar
Levine's Eosin Methylene Blue Agar, Difco

Specify "DIFCO"
THE TRADE NAME OF THE PIONEERS
In the Research and Development of Bacto-Peptone and Dehydrated Culture Media

DIFCO LABORATORIES
INCORPORATED
DETROIT, MICHIGAN, U. S. A.

A "MILLION TO ONE" SHOT

that always comes through!



PREPARE two beakers of hard water. To one beaker add 250 ppm. of soda ash only. To the other beaker add a flake of Calgon about the size of a pin-head, followed by 250 ppm. of soda ash.

PRECIPITATION in the first beaker will usually occur within five minutes. In the sample containing Calgon the reaction will be delayed for many days. This seemingly insignificant amount of Calgon prevents deposition of calcium carbonate — actually stabilizes a high degree of supersaturation.

THIS simple experiment shows you how an extremely small amount of Calgon stabilizes water after lime, or lime-soda softening.

You know that lime, or lime-soda softened water, usually contains excess calcium carbonate in solution . . . that unless this supersaturation can be effectively controlled, you get cementation of filter sands and scale deposits in water lines and water heater coils.

But, did you know that effective stabilization, with protection from corrosion, can be best obtained with Calgon? Added after the softening process, Calgon stabilizes water to the farthest extremities of the system and eliminates precipitation of calcium carbonate in mains and water heaters.

This means that you can maintain the maximum capacity of your mains, with flow unrestricted by scale formations. Equally important, you can render a real service to your customers by preventing expensive repairs to water heaters and avoiding replacements of increasingly critical metals.

You can accomplish all these benefits at a cost surprisingly low. The amount of Calgon needed runs from 1 to 5 ppm., depending on individual plant conditions. Send for complete information and a sample of Calgon.*

Calgon solves 4 water works problems

1. **Prevention of scale** from hard, high-bicarbonate waters. Calgon, added at the plant, prevents scale formation in mains, meters and hot-water heaters, throughout the system.

2. **Corrosion control**—Calgon forms a thin protective film on metals and metal oxides at pH values of 5.0 and higher. This reduces the attack of oxygen to such an extent that corrosion ceases to be a problem.

3. **Prevention of "red water"** — Calgon prevents the precipitation of dissolved iron. Thus "red water," either from iron initially present in well water, or from corrosion, can be eliminated.

4. **Stabilization of water** following lime or lime-soda softening. Calgon's ability to prevent precipitation of calcium carbonate stabilizes water to the ends of the system.

calgon, inc.
HAGAN BUILDING PITTSBURGH, PA.

**Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products.*

(*Continued from page 6*)

bearing higher preference ratings are shipped first, followed by lower rated orders.

"(5) We are permitted to ship during each month a *limited* number of orders *rated A-1-a or higher* without any waiting period and without specific Copper Branch approval, providing that no such single order calls for more than 2,000 lb. copper content in the finished material. Monthly limits on the amount of copper which may be so used are established by the Copper Branch and may vary from month to month.

"(6) An order may otherwise be shipped from stock or as soon as it can be manufactured only when a special directive to do so is issued to us by the Copper Branch.

"Thus it will be seen that "immediate" shipment is possible only when an order rated A-1-a or higher calls for less than 2,000 lb. copper content and our monthly quota of such orders is not exhausted, or when a special directive is issued to us. All other orders may be shipped in the second month following the month in which we receive them.

"In addition to the early placing of orders, all purchase orders should show (A) the preference rating properly extended to us, (B) correct production code or end use symbol, and (C) required delivery date. Without this information your orders cannot be placed on the copper report for the month in which they are received."

The above is reproduced to indicate how complicated and time consuming is the routine that the manufacturer of copper-bearing products must follow. Customers should cooperate by placing orders promptly and keep their patience.

"War Insurance" is being carried or planned by numerous utilities in varying ways. Abstracts of some plans follow:

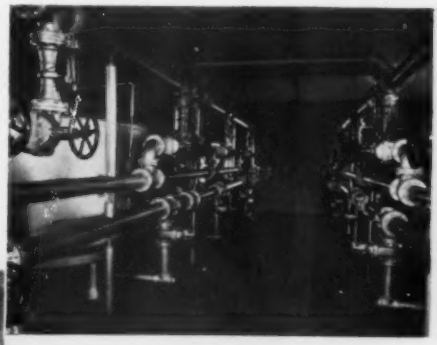
One utility company carries an excess loss contract covering all properties which are in several states; first $50,000 of damage not included; total limit of liability, $1,000,000; premium, 30 cents per $1,000 of gross revenue derived from all operations; gross revenue in policy, nearly $9,000,000.

Another utility company covers 83 plants with a very special contract with low premium due to wide variety of locations and more than one type of utility service; loss up to $50,000 not included; top limit of coverage $250,000 for any incident.

A large utility covers properties along the seaboard and in certain war industry communities, covering only pumping stations, dams and impounding reservoir retaining walls and excluding distribution lines upon theory that insurance of entire distribution system would be excessive cost and the utility is accustomed to repairing mains; may consider insurance of distribution system if and when bombs come.

(*Continued on page 10*)

A *Complete* Service . . .





an *Undivided* Responsibility

IN THE production of equipment for the conditioning of water, Graver offers a service broad in scope, yet unified under the control of men long experienced in this highly specialized work.

This service is complete, including designing, engineering, and fabrication of every unit to meet your individual requirements, and provides the unique and highly important advantage of a single responsibility for the entire job.

WATER SOFTENERS
FILTRATION SYSTEMS
CLARIFIERS
SEWAGE EQUIPMENT
STEEL STORAGE TANKS
VAPOR CONSERVATION SYSTEMS
WELDED CONSTRUCTION
STRESS RELIEVING
X-RAYING
FABRICATED STEEL AND CORROSION-RESISTING PLATE

Whenever you require equipment for the conditioning of water supplies, you will find it particularly advantageous to consult Graver. There is not the slightest obligation in doing so.

GRAVER

GRAVER TANK & MFG. CO., INC.

4809-17 Tod Ave.
EAST CHICAGO, IND.
CABLE ADDRESS — GRATANK

NEW YORK CATASAUQUA, PA. CHICAGO TULSA

42-35-W

(*Continued from page 8*)

Another utility insures above-ground productive structures in war production communities.

Still another utility insures structures that it considers vulnerable and damage to which would result in heavy expense for repairs; structures covered include above-ground sections of aqueduct, all filter plants, some pumping plants, general office, corporation yard and transportation and construction equipment stored in yard; no insurance for dams, distribution storage tanks or distribution system; distribution system not considered because of high insurance cost and utility's plans to make necessary repairs.

All construction, whether federal, state, municipal, military or civilian, will now be reviewed and passed upon by one of two boards, according to an announcement on October 22 by Donald Nelson, WPB Chairman.

Ferdinand Eberstadt, WPB Vice-Chairman in charge of program determination and materials allocation, has been made Chairman of the newly organized Facility Clearance Board which will pass on all new projects costing over $500,000, whether military or civilian or publicly or privately financed.

(*Continued on page 12*)

VOGT FIRE HYDRANTS

Standard—
"Traffic Model"—
Flush Type—
Water Crane
Type



VOGT GATE VALVES



Non-Rising Stem—Outside Screw and Yoke—Hub End—Flanged End—Ends to Fit any Type Pipe.

Also—Floor Stands, Shear Gates — Tapping Sleeves and Valves, Flap Valves and Mud Valves.

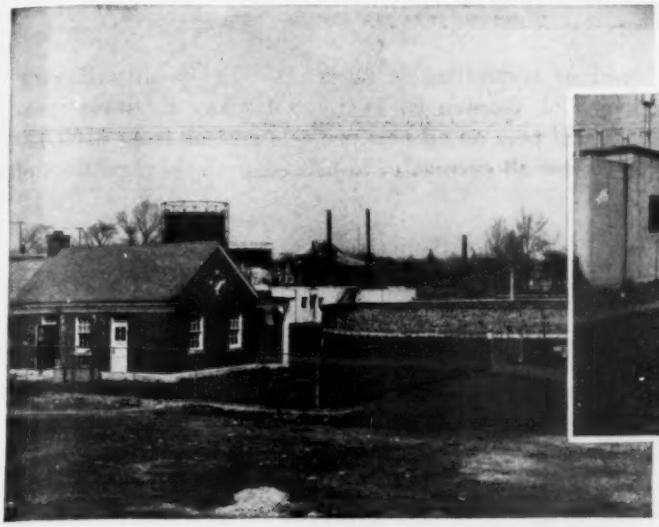
VOGT BROTHERS MFG. CO.
INCORPORATED
MAIN AT 14th ST.
LOUISVILLE, KENTUCKY

Meter Boxes
Meter Testers
Meter Yokes & Couplings

Valve Boxes
Service Boxes
Manhole Covers

Street Castings
Special Castings

H. W. CLARK COMPANY
Mattoon, Illinois, U. S. A.





G. L. Palmer, Superintendent

Stroudsburg, Pa. USES MATHIESON CHLORINE & HTH *for sewage treatment*

"(And)... we are completely satisfied," says Gilbert L. Palmer, Superintendent

● Mathieson Chlorine and HTH have been used in this modern sewage treatment plant at Stroudsburg, Pa. since the plant was first put in operation in 1937. Both products have been used continuously since that time . . . rendering "completely satisfactory" service. Mathieson Chlorine for post-chlorination and HTH in the dosing chamber for the elimination of filter flies—also for regular dosing of the beds.

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(*Continued from page 10*)

The second board or committee is known as the Facility Review Committee, headed by Col. Gordon E. Textor, an Army Engineer associated with WPB. It will pass on all new projects costing from $100,000 to $500,000 and will review all current or approved projects regardless of their cost.

Gordon M. Fair, Professor of Sanitary Engineering at Harvard, recently returned from a 15,000-mile trip through Central and South America. He went as Engineer-Consultant for the Division of Health and Sanitation, Office of Inter-American Affairs.

Thomas J. Eaton, for the past 8 years Superintendent and Hydraulic Engineer, Amsterdam, N.Y., Bureau of Water, has been commissioned a Captain in the U.S. Army Sanitary Corps and temporarily assigned to the Officers Training Battalion, Carlisle Barracks, Pa. Capt. Eaton was with the Pitometer Co. for 7 years before going to Amsterdam.

Arthur Rynders, Mechanical Engineer, Milwaukee City Engineer's Office, has been commissioned a Lieutenant in the Naval Reserve. He had been with Milwaukee's water department for 18 years.

Herbert M. Ihling, Field Engineer in Milwaukee's Water Dept., has been commissioned a Lieutenant in the Naval Reserve. Readers will recall Lt. Ihling's April 1942 JOURNAL article on laying mains.

Stanley T. Barker, who is on military leave from his position as Senior Sanitary Engineer with the New York State Dept. of Health, has been on duty in the Civil Engineer Corps of the U.S. Naval Reserve since November 1940, first as Lt. Commander and recently as Commander. He has served continuously in the Aviation Facilities Division of the Bureau of Yards and Docks and is now both Executive Assistant to Capt. F. R. Hewes, the head of the Division, and is also Project Manager in the Bureau for the construction of a number of Naval Air Stations.

Ezra B. Whitman, Consulting Engineer of the firm of Whitman, Requardt & Smith, Baltimore, has been elected President of the American Society of Civil Engineers for 1943. Mr. Whitman has long been well known in the water works field and has been a member of the A.W.W.A. since 1910.

Marion L. Crist has formed the firm of Marion L. Crist & Associates with an office in Little Rock, Ark., for consulting engineering work in connection with water works and sewerage. Due to the great demand for sanitary engineering work in connection with defense projects, Mr. Christ separated his office from the Little Rock Municipal Water Works. Be-

(*Continued on page 14*)



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KENNEDY
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(Continued from page 12)

sides the Little Rock Municipal Water Works, the firm is currently serving as consultants for the Japanese Relocation Center at McGehee, Ark., for improvements on water works at Stuttgart and Camden, Ark., and as designing and supervising engineers on additions at Camp Robinson.

Herman Meyer, formerly Associate Public Health Engineer of the U.S. Public Health Service, assigned to the Bureau of Sanitary Engineering of the Florida State Board of Health, has left that position and is now Assistant Professor of Mathematics, University of Miami, Coral Gables, Fla.

Maj. John C. Pritchard, who has been Area Engineer in charge of construction at Newport, Ark., has been transferred to Little Rock to supervise work at an airfield.

W. W. Towne, who was granted leave of absence from the position of Director of Sanitary Engineering, South Dakota State Board of Health, to accept a commission as Sanitary Engineer (R), U.S. Public Health Service, is now stationed at the 5th Reg. O.C.D. in Cleveland, Ohio. He has held the position in South Dakota since July 1929, except for nine

(Continued on page 16)

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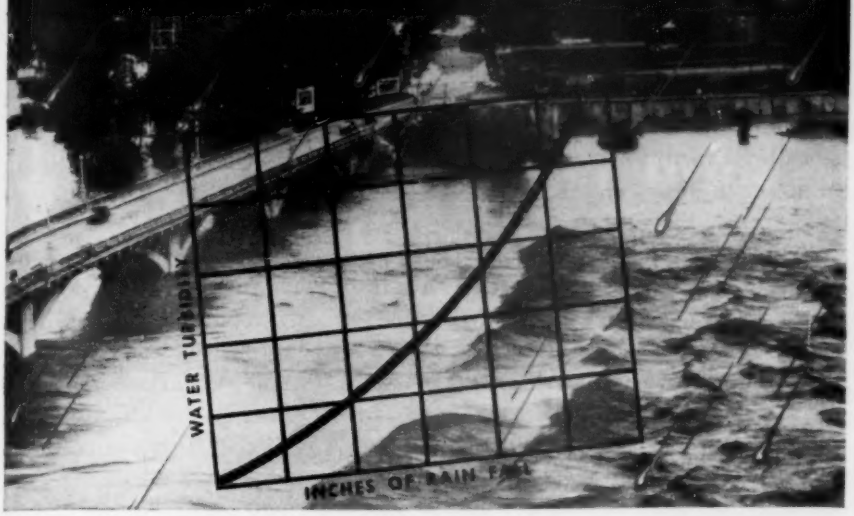
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501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Canada

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Pacific Coast Technical Service Offices: San Francisco • Los Angeles
Pacific Northwest Technical Service Offices: Wenatchee (Wash.) • Yakima (Wash.)
In Canada: The Nichols Chemical Co., Ltd. • Montreal • Toronto • Vancouver

(Continued from page 14)

months on leave of absence to serve as visiting Assistant Professor, Dept. of Civil Engineering, University of Missouri, from September 1941 to June 1942.

W. M. Cobleigh, Dean, School of Engineering, Montana State A. & M. College, has been named Acting President of Montana State. He was the Montana recipient of the Fuller Award in 1941.

Fletcher W. Pearce, formerly Associate Professor of Sanitary Engineering, North Carolina State College, Raleigh, N.C., is now at Northern Montana College, Havre, Mont.

Enrique E. Lilue, formerly Assistant Engineer with the Ministry of Public Works, Caracas, Venezuela, has been appointed Assistant Director of the Federal District Water Works in Venezuela.

Kaarlo W. Nasi has been appointed Assistant Sanitary Engineer in the U.S. Public Health Service and is stationed in the Health Service's Plague Suppressive Measures Division, San Francisco. He was a graduate

(Continued on page 18)

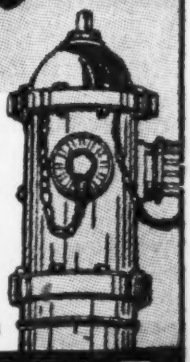
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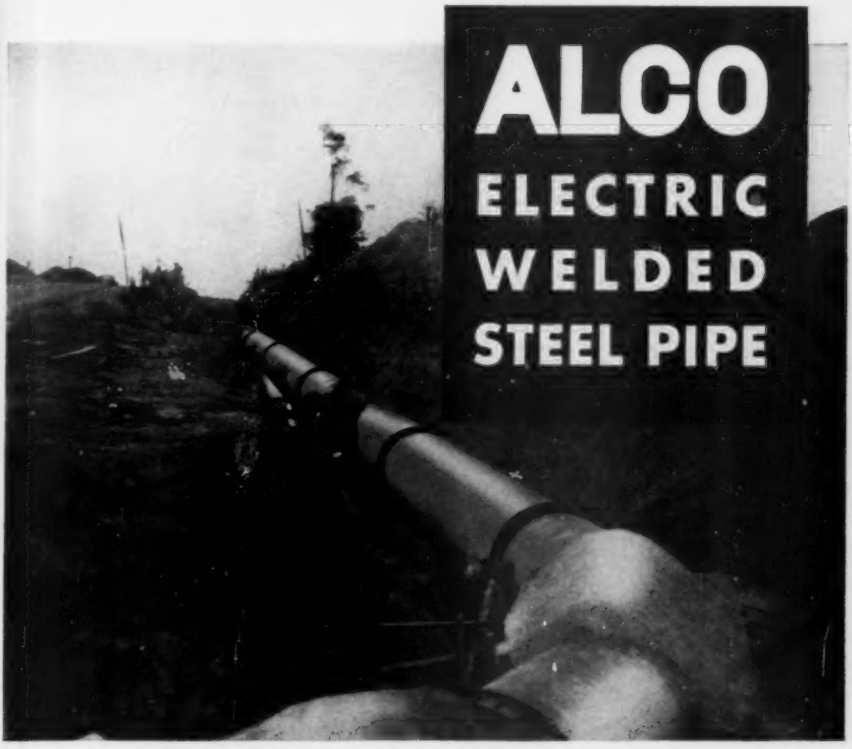
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(Continued from page 16)

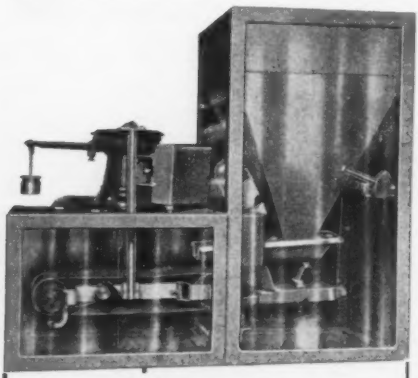
student at M.I.T. during the past year and was previously Public Health Engineer, Territorial Dept. of Health, Juneau, Alaska.

Francis M. Johnson, formerly Sanitary Engineer, District Health Department, with headquarters at Murphy, N.C., is 1st Lieutenant, Office of Post Engineer, Presque Isle Army Air Field, Presque Isle, Me.

Howard H. Potter, State Water Co-ordinator for Maine, left that position on October 19 to take up the duties of Regional Sanitary Engineer, Office of Civilian Defense, 17 Court St., Boston. J. Elliot Hale, Supervising Sanitary Engineer for the Maine Bureau of Health, has been serving as Assistant Water Co-ordinator and he will now assume the duties of State Water Co-ordinator.

Paul A. Chorney, Superintendent and Filter Plant Operator for the Ogdensburg, N.J., Boro Water Dept., was inducted into the armed forces on September 10 and is now attending the Air Corps Photographic School, Lowry Field, Colo. Before his employment with the Ogdensburg Boro Water Dept., he was a chemist for the New Jersey Zinc Co.

(Continued on page 20)



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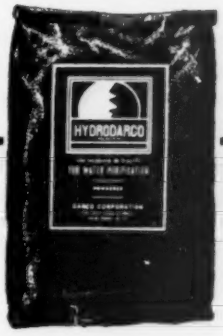
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(Continued from page 18)

Norman W. Parsons, who entered active military service in December 1940, is now serving abroad with a commission as Major. Before active military service, he was County Sanitary Engineer, New Cumberland, W.Va. He studied engineering at West Virginia University.

REPORT OF ROCKY MOUNTAIN SECTION MEETING

A Cheyenne boy who made good was guest of honor at the Annual Meeting of the Rocky Mountain Section held at Cheyenne, Wyo., September 17 and 18, 1942. He was W. W. Hurlbut, Assistant Chief Engineer and General Manager of the Los Angeles Bureau of Water Works and Supply. He and Mrs. Hurlbut were met at the train the evening before the meeting began by a large delegation of Rocky Mountain water works men, four police cars with wide-opened sirens, and representatives from the local newspapers.

Mayor Ed Warren of Cheyenne, in his welcoming address to the meeting gave honorable mention to Mr. Hurlbut. Del Porter, outgoing Chairman, in his opening speech stressed the need for all water superintendents and city engineers to support the Scrap Metal Salvage drive.

An innovation in the program this year was the showing of a motion picture each half day. The movies greatly stimulated interest, and more lively discussions than at previous meetings resulted. The manufacturers' representatives were requested to have no open-house rooms at any time during the sessions. This request was strictly adhered to and, consequently, everyone attended all the sessions.

Opening the first afternoon session, R. D. Goodrich, Dean of Wyoming University's College of Engineering, gave an excellent description of Laramie's ground water experiences (see text of this issue of the JOURNAL).

(Continued on page 22)

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ARMCO ARMCO **SPIRAL WELDED PIPE**

MEETS A.W.W.A. STANDARD SPECIFICATIONS

(*Continued from page 20*)

Dr. Frank C. Foley of the U. S. Geological Survey gave "The Geology and Development of Underground Water in Laramie County."

Two outstanding events on the program were an extemporaneous talk and blackboard drawings by Dr. S. H. Knight, Professor of Geology, University of Wyoming, and a round table discussion led by Maj. William H. Cary, Jr., Regional Sanitary Engineer.

Dr. Knight described the geology of Wyoming and Western Colorado and gave a very clear picture, with blackboard sketches, of the reason for the topography, mineral hot springs, the presence of artesian water, high plateaus, and the Continental Divide in this region. Two hundred million years ago there existed a sea coast running north and south through Western Colorado and Wyoming. Rainfall in the mountains west of this coast washed material east into layers two to four miles thick, consisting of shale, sandstone and sand. The thrust of the earth's crest upward made up-warps and down-warps. One-hundred and forty million years ago major folds and minor folds resulted in mountains and intervening basins. These were subject to erosion which shifted rock debris and the most resistant rock formed the mountain folds. This resulted in a lake in Wyoming 10,000 sq.mi. in area at one time. This basin rose, due to

(*Continued on page 30*)

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Changes in Membership

NEW MEMBERS

Applications Received Sept. 1 to 30, 1942

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Boles, Claude E., San. Engr., Caddo-Shreveport Health Unit, 227 Merrick St., Shreveport, La. (Oct. '42)

Carl, Kenneth J., Engr., National Board of Fire Underwriters, 85 John St., New York, N.Y. (Oct. '41)

Caster, Arthur D., San. Engr., Charles H. Hurd Co., 321 E. 51st St., Indianapolis, Ind. (Jan. '42)

Clark, Bradford N., Sr. San. Engr., U.S. Engr. Office, New York Dist., 120 Wall St., New York, N.Y. (Oct. '42)

Culver, Robert H., Asst. San. Engr., U.S. Engr. Dept., A.P.O. 845, Utilities Div., c/o Postmaster, New York, N.Y. (Oct. '42)

De Hart, Jessup, Mech. Engr., Public Service Co. of Indiana, 1511 Maple Ave., Noblesville, Ind. (Oct. '42)

Gardner, Leigh O., Designing Engr., 215 S. 22nd Ave., Phoenix, Ariz. (Oct. '42)

Heiss, Edward A., Pacific Northwest Div. Mgr., Wallace & Tiernan Sales Corp., 917 Terminal Sales Bldg., Seattle, Wash. (Oct. '42)

Hess, John S., Chief Engr. of Refineries, Sinclair Refining Co., 630 Fifth Ave., New York, N.Y. (Oct. '42)

Leitch, Kelvin D., Treas., Arthur S. Leitch Co., Ltd., 1123 Bay St., Toronto, Ont., Can. (July '42)

Mengel, Arthur C., Chief Chemist, American Locomotive Co., Ballston Lake, N.Y. (Oct. '42)

Mercer, B. F., Water Comr., City Water Dept., Sidney, Mont. (Oct. '42)

Monroe, Owen, Vice-Pres. & Treas., Heldt-Monroe Co., 201 N. Main St., Evansville, Ind. (Oct. '42)

Porter, Harry, Dist. Mgr., Peoples Water Service Co., Bastrop, La. (Oct. '42)

Sheehan, Edward D., Supt., Water Dept., City Hall, Camden, N.J. (Oct. '42)

Sherard, Ray L., Supt. of Water System, 3010 Cribbon Ave., Cheyenne, Wyo. (Oct. '42)

Sletten, Owen, Bacteriologist, Coca-Cola Bottling Co., 2035 University St., S.E., Minneapolis, Minn. (July '42)

Smith, Virgil D., Supt., City Water Dept., Azusa, Calif. (Oct. '42)

Swanson, Joe, Supt., City Water Dept., Sierra Madre, Calif. (July '42)

Teasleef, Claude V., Supt., Water Works, Dugger Utilities, Dugger, Ind. (Oct. '42)

Trostle, N. E., Water Supt. & City Engr., Temple Water Dept., 1314 S. 21st St., Temple, Tex. (Oct. '42)

Trowbridge, A. L., Mgr., California Water Service Co., 1417—17th St., Bakersfield, Calif. (Jan. '42)

Trygg, Charles E., Civ. Engr., McGregor, Iowa (Jr. M. Oct. '42)

Wade, Newton B., City Engr., 228 E. Main St., Millville, N.J. (Oct. '42)

Walsh, Zelma Q. (Miss), Chemist, Water Dept., c/o Post Engr., Camp Butner, N.C. (Jr. M. Oct. '42)

Waring, William H., Mgr., Transite Pipe Sec., Johns-Manville Sales Corp., 1000 Market St., St. Louis, Mo. (Jan. '42)

Young, J. L., Supt., Benton Munic. Water Works, 619 Market St., Benton, Ark. (Oct. '42)

REINSTATEMENTS

Jackson, James A., San. Engr., State Board of Health, 1098 W. Michigan St., Indianapolis, Ind. (Oct. '38)

Languell, Louie, Supt., Salem Water Works, Salem, Ind. (Apr. '39)

Wilson, J. B., San. Engr., Bevington-Williams, Inc., 5300 Boulevard Pl., Indianapolis, Ind. (Jan. '39)

LOSSES—DEATHS

Connell, William B., Pres., Chemical Engineering Labs., 2800 Logan St., Dallas, Tex. (Aug. '30)

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Changes in Address

Changes of address between September 15 and October 15, 1942

Baldwin, Boone, City Mgr., Water & Light Dept., Paris, Ky. (July '42)

Bivins, J. F., *see* Mount Airy, Town of

Brannen, Francis M., Box E, Georgia School of Technology, Atlanta, Ga. (Jan. '42)

Cook, James R., Box 1026, Chappaqua, N.Y. (Jan. '37)

Craig, Charles P., 419 Hawthorne Ave., Williamsport, Pa. (Jan. '42)

Crist, Marion L., Engr., Marion L. Crist & Assoc., Union Life Bldg., Little Rock, Ark. (Feb. '33)

Cushing, R. M., Designing Engr., Headman, Ferguson, Carollo, Engrs., 948 Ash Ave., Tempe, Ariz. (July '41)

Dong, Yen H., 820 W. 80th St., New York, N.Y. (Jr. M. Jan. '42)

Ferguson, Gerald W., Asst. Public Health Engr., Bureau of Eng., State Board of Health, Jacksonville, Fla. (Jan. '42)

Fink, G. J., Consultant, 3620 Yuma St., N.W., Washington, D.C. (Apr. '24)

Gotaas, Harold B., Chief, Eng. Sec., Office of Co-ordinator of Inter-American Affairs, Dept. of Commerce Bldg., Washington, D.C. (Jan. '38)

Haywood, R. W., Jr., Water Supervisor, U.S. Rubber Co., Box 300, Williamsport, Pa. (Jan. '37)

King, H. McKay, Pembroke, Ky. (July '39)

Kroschwitz, Fred, Salesman, Mueller Co., 610 Bayview Ave., Seaside Heights, N.J. (July '40)

Leshkow, Nick, Plant Operator, West Virginia Water Service Co., 803 Harrison St., Princeton, W.Va. (Affil. Jan. '41)

Lilue, Enrique E., Asst. Director, Federal Dist. Water Works, Apdo. 486, Caracas, Venezuela (Oct. '39)

Mount Airy, Town of, J. F. Bivins, Supt., City Water Dept., Mount Airy, N.C. (Corp. M. July '37)

Nasi, Kaarlo W., Asst. San. Engr., U.S. Public Health Service, Plague Suppressive Measures, 14th Ave. & Lake St., San Francisco, Calif. (Jan. '38)

Pirnie, Malcolm, Jr., Asst. San. Engr., U.S. Public Health Service, 303 Hoge Bldg., Seattle, Wash. (Oct. '39)

Rudd, W. C., 201 E. Kirby Ave., Detroit, Mich. (June '23)

Sleeper, William H., 126-25—144th St., South Ozone Park, N.Y. (May '23)

Sterns, Edward A., Supt., Water Dept., 301 Pleasant Ave., Hamburg, N.Y. (Apr. '37) *Fuller Award '38.*

Stroyd, A. H., 400 N. Lexington Ave., Pittsburgh, Pa. (Jan. '41)

Wolff, William R., Assoc. Valuation Engr., Public Service Com., 80 Centre St., New York, N.Y. (Mar. '30)

MEMBERS ENTERING MILITARY SERVICE

Bach, Clayton M., Jr., Chemist & Water Bacteriologist, Minneapolis Water Dept., Minneapolis, Minn. (July '42)★

Estes, N. C., Dist. Mgr., Wallace & Tiernan Co., Inc., 2615 Fannin St., Houston, Tex. (Oct. '38)★

Grodin, Bernard, 1103 Knox Ave., N., Minneapolis, Minn. (Apr. '39)★

Jenkins, Joseph Edwin, Student Civ. Engr., 106 E. 20th St., Austin, Tex. (Jr. M. July '42)★

Johnson, Francis M., San. Engr., Dist. Health Dept., Murphy, N.C. (Oct. '37)★

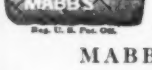
Kearney, E. W., State Board of Health, Morganton, N.C. (Jan. '30)★

Lee, W. S., Jr., Pres., W. S. Lee Engineering Corp., Power Bldg., Charlotte, N.C. (Jan. '36)★

Parsons, Norman W., County San. Engr., New Cumberland, W.Va. (Oct. '34)★

Smith, W. D., Sales Engr., Eshelman & Potter, 8 Augusta Drive, Greenville, S.C. (Apr. '41)★

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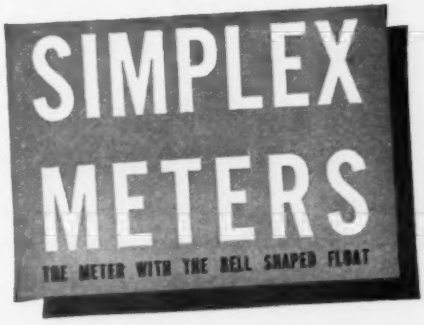
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(Continued from page 22)

erosion and re-etched mountains. The bottom, or lower, layer is called the basement complex and is too resistant to allow water to pass or enter it, as a rule. Water moving under hydro-static head forced out from the flanks of subsidiary folds caused numerous water springs. This resulted in the large spring, now near the Laramie range, which produces 14 cfs. of water. Hot springs were caused by the warped floors of folds into the basement complex, resulting in water coming from a depth of 10,000 ft. or more. This excessive depth causes the high temperature of this water. The largest hot spring produces 18 mgd. Good artesian water is produced on the edge of these folds and artesian wells give the greatest yields of water. The Powder River Basin of Wyoming was formed by the warping of steep folds in the secondary line, which is 10 to 20 ft. thick. The third, or top, deposits are what caused the high plains of Wyoming.

At the round table discussion, Major Cary presented information concerning the protection of water supplies, co-operation with the WPB, etc. Three state sanitary engineers, L. O. Williams, Jr., of Wyoming, T. A. Filipi, of Nebraska, and myself, of Colorado, partook in the discussion, and all reported on progress in each section in forming water works zones, obtaining water works inventories, training personnel and taking precautions against sabotage.

(A complete schedule of the program's authors, discussors and participants in round table discussions will be given in the December JOURNAL Summary of Section Meetings.)

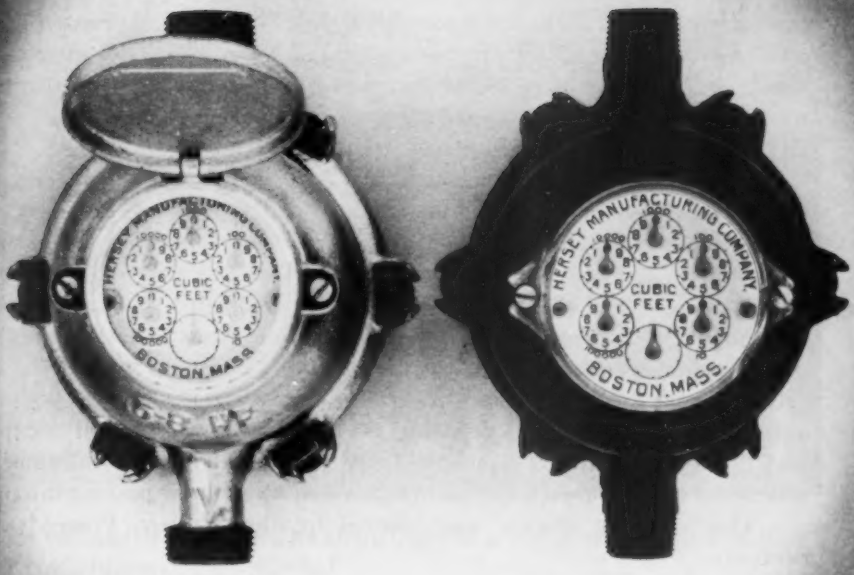
A Ladies' Bridge and Tea was given for the wives of those attending the meeting, on Thursday afternoon, and 25 were present. There were 86 registered attendants at the entire meeting, while the section membership stands at 83. Fifty-eight attended the Business Luncheon and 91 were at the banquet. The Governing Board met nightly in executive sessions.

The new officers elected are as follows:

Chairman—Henry G. Watson, City Engineer, Cheyenne, Wyo.
Vice-Chairman—Ernest Martinez, Manager, Taos, N.M.
Secretary-Treasurer—O. J. Ripple, Filtration Superintendent, Denver Board of Water Commissioners, Littleton, Colo.
Director—B. V. Howe, State Sanitary Engineer, Denver, Colo.
Trustees—K. E. Darling, General Manager, South Wyoming Utilities, Rock Springs, Wyo.
Ray C. Bollier, Water Superintendent, Alamosa, Colo.
George J. Turre, Chief Chemist, Denver Board of Water Commissioners, Denver, Colo.
Ben G. Davis, Superintendent of Pipe Line, Rawlins, Wyo.

B. V. HOWE
Secretary-Treasurer (Retired)

(Continued on page 32)



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(Continued from page 30)

REPORT OF WESTERN PENNSYLVANIA SECTION

The joint meeting of the Western Pennsylvania Section of the A.W.W.A. and the Western Pennsylvania Water Works Operator's Association which was held at the Roosevelt Hotel, Pittsburgh, on September17 and 18, was an exceptionally fine meeting. There were 152 men registered, and approximately 15 to 20 came to the meeting after registration was closed, and to the late afternoon session and banquet. Twenty-five ladies were present at the meeting.

On Thursday evening, September 17, to inaugurate the meeting, a very delightful smoker was held for the men and approximately 60 persons had an opportunity to meet and discuss "Wartime Effects on Water Supplies," and to do the usual reminiscing. This prelude to the regular meeting was a huge success and was enjoyed by all those attending.

The regular meeting got under way on time Friday morning and all of the papers presented were enthusiastically received. We believe the attendance at the meeting and the attention given to the papers presented indicated that water works personnel is on its toes in this critical situation and the men are all very much interested in receiving any information which will be helpful to them during the crisis we are now passing through.

The following officers were elected by the Western Pennsylvania Section:

Chairman—Chester F. Drake, Superintendent of Filtration, Pittsburgh

Vice-Chairman—E. C. Trax, Superintendent of Filtration, McKeesport, Pa.

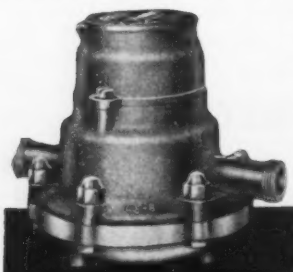
Director (one year)—Daniel E. Davis, Chester Engineers, Pittsburgh

Director (three years)—E. C. Goehring, Assistant Manager, Beaver Falls Municipal Authority, Beaver Falls, Pa.

Secretary-Treasurer—E. P. Johnson, Pittsburgh

(Continued on page 34)

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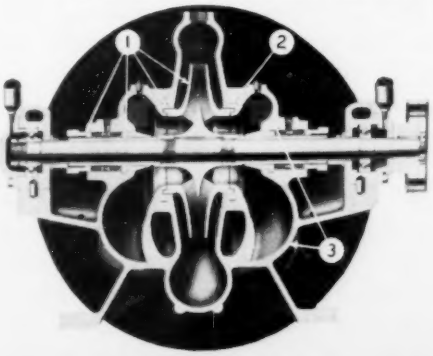
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(Continued from page 32)

It seems to be the opinion of the officers that short meetings for small sections of the A.W.W.A. will have larger attendances and more enthusiastic participation at the meetings. It is also their opinion that the joint luncheons are very advantageous in keeping the attendance together and is a great help in permitting the afternoon sessions to start promptly. It was the firm belief of everyone present that these meetings are necessary during these critical times but that they should be handled in a minimum of time, the place for the meeting being easily accessible by train and by bus

The Western Pennsylvania Section of the A.W.W.A. very much appreciated having the Western Pennsylvania Operators present and having their Secretary, I. N. Glace, present to lend a helpful hand when needed.

We are looking forward to 1943 to be a better year in the water works profession. Unquestionably we will all have to work with less, and will have to do more, as well as exercise our ingenuity as we never have before.

The officers of both associations wish to thank all of those who participated in the making a success of the meeting, and particularly those who made the program one of the finest ever presented by the Section. (The complete schedule of the program's papers will be given in the December JOURNAL Summary of Section Meetings.)

E. P. JOHNSON
Secretary-Treasurer

REPORT OF MINNESOTA SECTION MEETING

The 26th annual meeting of the Minnesota Section was held September 24–26, 1942, at the Hotel Lowry, St. Paul, Minn., with a total registration of 175. Harry E. Jordan, A.W.W.A. Secretary, was present. President Abel Wolman was expected also but due to an assignment by the State Department, was unable to attend.

September 24th was devoted primarily to talks on priorities and rationing of critical materials. After the address of welcome was given by Mayor McDonough of St. Paul, Wright W. Brooks of the Tire Rationing Board covered the tire situation. Mr. Brooks did state that there was some hope of water works men obtaining tires to be used exclusively in their work. These, in all probability, will be recapped or vulcanized. From the manufacturer's position, the loss of the East Indies was a serious blow, because, should we regain control of the islands the Japs would destroy the rubber trees before we got there. Synthetic rubber will be available but not until next year and then it will be needed for the armed forces.

In the afternoon, Lee Jensen of the WPB, Minneapolis, discussed priorities and explained various changes which have been made. He

(Continued on page 36)

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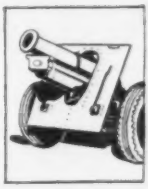
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(Continued from page 34)

pointed out the importance of making individual inventories available to all municipal water works within the state. The panel discussion which followed covered this matter thoroughly, and exposed weaknesses in the regulations to date. Secretary Jordan, speaking at another time, stressed the point about making inventories available. Inventories above government regulations (dollar value of prior date) do not mean that Mr. Jones will get Mr. Brown's surplus. He will receive it only if and when he needs it for immediate use. Ole Forsberg, Chemist, Oliver Iron Mining Co., Hibbing, Minn., added the comment that it took two tons of iron ore to equal one ton of scrap iron and his company is using men which it can ill afford to spare to collect scrap iron.

On Friday, September 25, Maj. William H. Cary, Jr., Regional Sanitary Engineer, Chicago, talked on "Water Supply in the Civilian Defense Program." He discussed the importance of full co-operation with the air raid warden services, told of what to look for from saboteurs and fifth columnists, and said that state lines should be forgotten in cases of extreme emergency. O. E. Brownell, Minnesota State Board of Health, explained what steps have been taken by municipalities in the way of defense.

(Continued on page 38)

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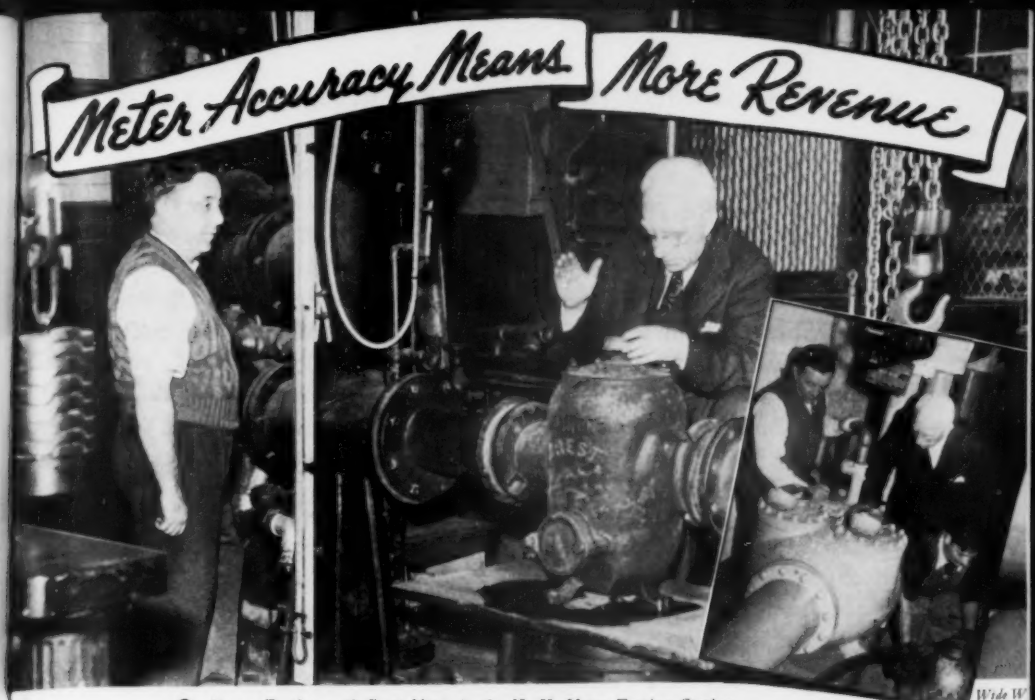
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A HUNDRED YEARS AGO thousands of New Yorkers flocked to City Hall Park to see the fountain display fed by the newly opened Croton Aqueduct. New Yorkers of that day were proud of their new System, which DeWitt Clinton had outlined in 1833 to deliver 20,000,000 gallons a day.

One hundred years later New York City's water supply system delivers an average of 880,000,000 gallons daily. The City now covers the whole of Manhattan Island and has spread out to include four other boroughs.

Today one of its greatest attractions is Rockefeller Center, business headquarters of thousands and the mecca for additional thousands of visitors. Deep in the sub-basements, never seen by the public, are large meters which record the daily water requirements of this large population.

The original estimate of the water requirements of the RCA building alone contemplated a demand rate of 20,000,000 gallons a day—equal to the original estimated capacity of the Croton System.

This demand would have put such a burden on the present system that engineers devised a way of using water over and over in the cooling and air conditioning systems so that the requirement was cut to $\frac{1}{3}$ of the original estimate.

Just what do meters mean to a city like New York? Of the 667,400 connections in New York City, 179,600 are metered, a large percentage in the larger sizes. From these metered services, which consume 22 per cent of the water, the City receives $16,400,000 or 42 per cent of its water revenues. But should these meters under-register as little as 3 or 4 per cent, the City would lose a staggering amount of money.

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(Continued from page 36)

Jack Whalen's paper on "Emergency Repairs for Water Supplies" will be published in the Minnesota Section Annual Bulletin, as will be V. W. Buy's paper on "Safety Appliance in Water Plants."

Papers and talks on water softening were given by Howard J. Sowden, Twin Cities Ordnance Plant, and Frank Raab, Minneapolis Softening Plant. W. D. Hurst's paper, "Taste and Odor Control," was read by Arthur F. Mellen. Mr. Hurst, Assistant City Engineer of Winnipeg, Man., was unable to be present.

At the business luncheon, committee reports were read and the following were elected to Section posts for the coming year:

Chairman—U. J. Seibert, Chemist, Filter Plant, St. Cloud, Minn.
Vice-Chairman—Frank Raab, Chemist and Bacteriologist, Fridley Filtration Plant, Minneapolis
Trustee (three years)—D. B. Morris, C. B. Lyon & Bro., St. Paul

Mr. Seibert presented Past Chairman W. P. Tarbell with the Past Chairman's pin. The Executive Committee appointed R. M. Finch Secretary-Treasurer for the coming fiscal year.

After the close of the business session, Secretary Jordan cited the progress made by the Minnesota Section in the past four years, and the

(Continued on page 39)



(Continued from page 38)

increase in national membership, and went on to discuss the dangers of increased water demands on ground water supplies, and other problems of the water works field.

Arthur F. Mellen, Filtration Engineer, Minneapolis Water Department, will be the Minnesota recipient of the Fuller award at the next National Annual Conference, it was announced at the banquet. The entertainment consisted of a floor show.

R. M. FINCH
Secretary-Treasurer

G. J. Fink formerly Supervisor of Research of the Lime Products Section, U.S. Gypsum Co., Chicago, transferred on October 1 to Washington, D.C., where he is located at the National Bureau of Standards as Research Associate, supervising co-operative research of the Bureau and the National Lime Association on masonry mortars. He will also supervise and co-ordinate other research on lime which is sponsored by the National Lime Assn. Mr. Fink was Technical Director of the National Aluminate Corp. in Chicago before his association with the U.S. Gypsum Co.

(Continued on page 40)

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(Continued from page 39)

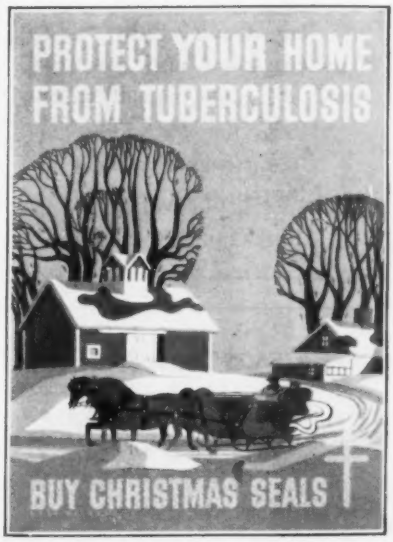
"Safeguarding Records From Air Raids" is a report from about fifty companies compiled by and available upon request to E. H. Conarroe, Director, Management Service, Policyholders Service Bureau, Metropolitan Life Insurance Co., New York, N.Y. The report tells how these organizations, including utilities, have assigned responsibility for safeguarding their records, how they have determined what material required safeguarding, and how it was to be done. The handling and distribution of duplicate records of accounts receivable, continuing property records, general corporate records, personnel records and statistics, and maps of distribution systems are covered.

Fred E. Stuart of Stuart-Brumley Corp. and Activated Alum Corp. has originated a new whisky called Stuart's pH Controlled Whisky which is being made by the Stuart Alkaline Liquors Co. of Baltimore. Stuart noted that most available hangover cures are alkaline and so developed a whisky with a pH of 7.2. To do this he discovered an alkalizing agent which neutralizes the objectionable acids and then removes them by precipitation and filtering. He cautiously states that his pH Controlled Whisky "seems to agree with many people a lot better than the acid type of whiskies."



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Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

NEWS OF THE FIELD

MANPOWER: A Summary of the British Experience

(Excerpts from "Public Administration Service No. 84" by Eric H. Biddle)

"Manpower," a term virtually unheard a year or two ago, has come to be a byword because it expresses an entire set of assumptions about the way total war must be waged. . . .

In total war the nation must direct all its resources to the war task, welding all institutions and individuals into a single coherent organization for a single purpose. The manpower program affects every aspect of war policy. It is, so to speak, the personnel program of the national organization for total war. . . . It is no longer possible to assume that we can go on indefinitely selecting the best machine tool operators, the best chemists, or the best laborers, executives, and doctors for industrial and civilian needs, and at the same time supply all the demands of the armed forces. In short, the currency of the day is critical materials and manpower, and it is especially true of the United States that manpower basically determines the limits of the war effort. . . .

The question is not what proportion of our manpower shall be devoted to the war effort and what part to other occupations. It is rather how soon and how efficiently we can allocate to the several military and civilian aspects of the war effort our entire supply of skills. Just as the army must balance the number of men assigned to combat service against the number in administrative and auxiliary functions, so the entire personnel of the fighting forces must be balanced against the personnel engaged in direct production of essential supplies such as food or munitions. Finally, both these must be balanced against the manpower for necessary auxiliary services of society.

In total war the civilian population must share with the military the responsibility of national service. If this responsibility is to be properly discharged, civilians must be supplied, housed, and provided with essential services. All these problems, in the interests of the armed forces as well as the civilian population, must take equal place with military needs in national policy and national administration. In a chain, no link is less important than another. . . . It should be taken for granted that everyone will work or fight. The question is how he can best help win the war. Unnecessary expenditures, whether by government, by private corporation, or by individuals, must be stopped. The problem is how to select the expenditures to eliminate and how to proceed to enforce the elimination. If a long war is forecast, and that is the only prudent assumption, then the

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allocation of skill and individual capacity must take precedence over everything, including family status, in considering deferments from military service. If we examine this proposition carefully, it will be seen that neither sound social policies nor economic and military considerations justify making family status the controlling basis for deferment. . . .

Broad British Purposes

Broadly viewed, the British manpower program has three main purposes. Its first is to assign each citizen to a place where his skill will be best used; the second is to see that he is cared for fairly and as well as wartime conditions permit; the third is to base the enforcement of the system primarily on general consent, notwithstanding the fact that the broadest compulsive powers have been conferred upon the government. . . .

Those in charge of the British program understood from the beginning that the most rigid rationing of skills would be necessary. They foresaw that at the time of full mobilization the ultimate limitation upon the war effort would be a shortage of human skills and energies, indeed that every conceivable bottleneck, whether it be in materials, transportation facilities, or finished munitions, would be the result of an ineffective use or allocation of human skills.

The government took it for granted, therefore, that the assignment of men to military service should not be conditioned by family status; that, in short, it would be far more economical to support a man's dependents than to send to the armed forces in his stead someone whose skill would make a greater contribution to the national effort if used elsewhere. (However, men were called up by age groups, the younger first, and in each group the single men were called first.) The government considered the question which men to send to the armed forces mainly from the view of fighting power. And so far as civilian employment was concerned, the government considered just as critically the case of the munitions factories that hoarded valuable technicians and used them uneconomically as the case of employers in less essential work.

A second type of assumption implicit in the British manpower program was that the powers of compulsion should in practice be extended gradually, and should not be applied faster than an organization could be constructed to administer them efficiently. . . . A manpower program is not devised by planning an ideal strategy and setting up an ideal schedule of production and then assigning the personnel to put them into effect. The necessary approach is to consider everyone responsible for his highest potential contribution to the war effort, and consequently to consider manpower as a fundamental in every stage of planning, from that of the highest global war strategy down to the detailed method of how to supply every farm and every work bench with the essential manpower. . . .

(*Continued on page 4*)



A MILE OF CAST IRON PIPE

SALVAGED and SOLD

FOR APPROXIMATELY ITS ORIGINAL COST

NEARLY forty years ago, at South Fork, Pa., about a mile of 8-inch pipe was installed to supply water to a coal mine. Last year the line was abandoned *but not the pipe*. This was *cast iron* pipe which can be salvaged or re-used. It was dug up and salvaged for cash at a price approximately equal to its original cost—after nearly forty years of service. We have on file many records of old cast iron mains which have been taken up and re-used, or sold to other cities for re-use, or sold as scrap.

Pipe bearing this mark is cast iron pipe.

Available in diameters from 1¼ to 84 inches.

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CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

Cataloging Occupations

The initial British plan of assigning persons to military or civilian service rested upon the basis of a national catalog of occupations known as the Schedule of Reserved Occupations. . . .

The draining off of skills by the dependence upon the volunteer system in the early years of World War I made it necessary to recall large numbers of men from the armed forces toward the end of the war, to the detriment of the war effort. Out of this experience grew the significant recommendations made in 1924 by the Imperial Defense Committee of the Cabinet.

First, the entire manpower program, including military recruitment and all civilian labor supply, was made the responsibility of one integrated manpower agency, the Ministry of Labor and National Service. . . . In drafting the Schedule, the Ministry of Labor set about defining every occupation, giving particular care to critical industrial occupations, and checking the adequacy of the definitions with employers' organizations and trade unions. At the same time the Ministry proceeded to classify the industrial plants of the nation. Next, in consultation with the armed forces, the specialized military occupations, that is, those occupations that required a background of skills normally acquired in civilian life, were defined under the term "Service Trades." Finally, the civilian occupations were listed by industry groups, and late in 1938, with the co-operation of the Employers' Federation, an occupational census was taken to discover the actual distribution of skills by industry and by geographical location. At the same time, the Employment Exchanges took an occupational census of the unemployed. Then the armed forces made a survey of the anticipated wartime manpower requirements.

On the basis of all this information, it was possible to bring the anticipated material requirements of the war program into balance with the manpower to be retained in war industry, and to bring both of these into balance with the needs of the armed forces for manpower. The Schedule of Reserved Occupations was designed to be the sheet anchor of manpower allocation. . . .

Control of the Use of Manpower

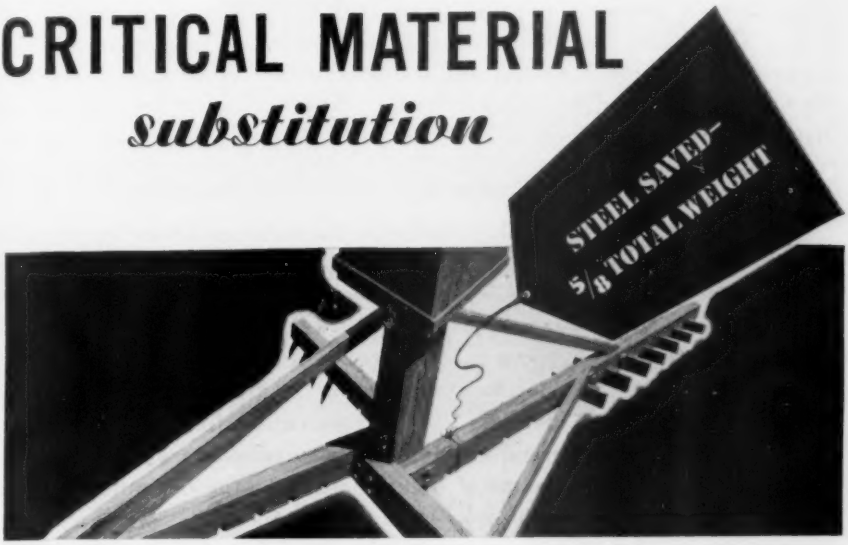
Because of the need for increasing domestically produced food supply, the age of reservation of farmers and farm labor was placed very low. With respect to each of the most critical industrial skills, it was provided that when men below the age of reservation were called up they could not be inducted into the armed forces unless they were to be employed in the Service Trade that was linked with their civilian occupation, in other words, unless their skill was to be used to the fullest advantage. . . . The armed forces, furthermore, were expected not to waste their supply of critical skills. . . . At a later stage as manpower scarcity developed, the government

(*Continued on page 6*)

a frank statement of what we're doing about

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We can't build a plastic Clarifier—or Flocculator—or Hydro-Treator. Critical material substitution is, for us, a slow and painful process. It won't enable us to supply you for less money—and in most cases you'll have to wait a bit longer for delivery due to design changes. But it *will* enable us to make more equipment available—with less critical material consumption. And in most cases these substitutes can be replaced with the original materials when "criticals" are again available.

The DORR COMPANY Inc.

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ATLANTA TORONTO CHICAGO DENVER LOS ANGELES

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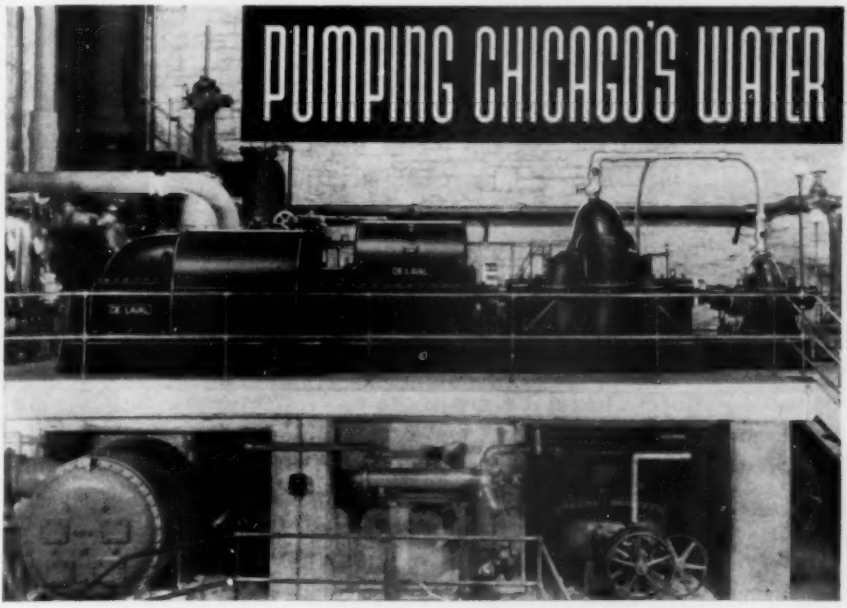
was required to take other steps to insure that the armed forces would use their supply of skills efficiently. . . .

In promulgating the Schedule of Reserved Occupations, the policy was to establish for each essential skill the lowest possible age of reservation —that is, to reserve as many men with that skill as possible, and, at the same time, to provide the armed forces with the necessary supply of that skill. The British government was determined not to be caught with too many skilled men in the army and too few in those occupations on which the army depends for maintaining a balanced production. The Schedule of Reserved Occupations was considered a flexible instrument. . . .

Refinement of System to Point of Individual Cases

A major step to refine the system for the national allocation of skills was taken at the end of 1941 when the wartime economy was approaching complete mobilization. The change of policy has commonly been described as a change from the system of block reservation, or the reservation of entire occupations by age groups, to a system of individual deferment. . . . In brief, the change of policy was this: as of the first day of each month, beginning January 1, 1942, the age of reservation for each occupation in the Schedule of Reserved Occupations was raised by one year, with the exception of a few groups of occupations. At the beginning of each month, therefore a certain proportion of the men who were formerly reserved by the Schedule become available for military conscription, provided they are not already in, or may not be assigned to, essential war work. Most of the men of military age with important skills who had been previously reserved from military conscription were already in essential industries or had voluntarily transferred to war work. Thus, in December of last year [1941] the following facts were taken into consideration: (1) that the armed forces were approaching their peak of mobilization; (2) that the manpower needs of war production and other essential services were more precisely known; and (3) that the concentration of less essential industries was approaching the end. Thus it was obviously desirable at this point to review the case of every person who had been formerly reserved by the Schedule to ascertain whether he should remain in his present employment, be transferred to a more vital occupation, or be called up for military service. The age of reservation was raised progressively month by month in order to make it possible for the District Manpower Offices, which were established for that purpose by the Ministry of Labor and National Service, to review each individual case. . . . The system of assigning everyone to his place applies not merely to the armed forces but also to civilian occupations. Through several types of controls, the government has power to direct anyone to any employment, to prevent him from leaving or being discharged if he works in an essential industry, and to require

(Continued on page 8)



80 m.g.d. De Laval geared turbine driven pump in Springfield Ave. Station.

CHICAGO is renowned for its efficient and modern pumping stations. Of the total capacity of pumping equipment regularly used by the City, 1,020,000,000 gallons per day is provided by De Laval geared turbine and motor driven pumps, located as follows:

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CENTRAL PARK AVE. STATION: three geared turbine driven pumps, each of 60 m.g.d. capacity.
WESTERN AVE. STATION: four geared turbine driven pumps, each of 75 m.g.d. capacity.
MAYFAIR STATION: two geared turbine driven pumps, each of 60 m.g.d. capacity.
SPRINGFIELD AVE. STATION: four geared turbine driven pumps, three of 60 m.g.d. and one of 80 m.g.d. capacity.

The unit latest installed was the 80 m.g.d. unit at Springfield, the official acceptance tests of which were made in June, 1938. Using steam at 175 psig. with 150°F. superheat and pumping against 187 ft. head, a duty of 222.8 million foot pounds per thousand pounds of steam, as corrected to contract conditions, was obtained. This unit has been in continuous service since started in May, 1938. A delivery rate of 96 m.g.d. has been maintained on several occasions and 110 m.g.d. has been reached.

There is also soon to be installed at the Roseland Pumping Station a geared turbine-driven centrifugal pumping unit to deliver 75 m.g.d. against 215 ft. total head, corresponding to approximately 3000 horsepower, or 50 m.g.d. against 240 ft. total head. The turbine will receive steam at 375 psig., with 175°F. superheat, exhausting to a condenser receiving circulating water at temperatures varying from 55° to 70°F.

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(*Continued from page 6*)

employers in the most vital industries to employ their workers through the Ministry of Labor's local Employment Exchanges. . . .

In setting up conscription for military service Parliament has enacted a series of National Service Acts which establish the age limits for conscription and the other conditions governing the call for military service. These statutory limitations govern the Minister of Labor and National Service in developing the recruiting plan for the armed forces. But there is no statutory limitation on the Minister's authority to direct persons to civilian employment. . . .

It would be useless to assign men and women to vital work if a high rate of turnover were to reduce the efficiency of the undertaking. The British government found it necessary to prevent employers in war industries from hiring workers away from one another.

First, the Ministry of Labor and National Service prohibited employers in certain vital industries from advertising for or otherwise soliciting for workers, and required such employers to hire their workers only through the local Employment Exchanges of the Ministry (the Restriction on Engagements Order). Second, the Ministry has required that all women between the ages of 18 and 31, shall be employed only through local Employment Exchanges, irrespective of the occupation or activity for which they are employed (Control of Engagements Order). Third, the Ministry has issued a series of "Essential Work Orders" which apply to particular plants in certain broad categories of essential work. These orders prevent an employee from leaving his job or an employer from discharging him except in case of serious misconduct or with official permission. They also explicitly define certain obligations of the employer concerning wages and working conditions, and certain responsibilities the worker has toward his employer. . . .

In total war a manpower policy must emphasize organization and specialization. In other words, there must be an efficient national manpower organization so geared as to provide a systematic flow of information regarding the national pattern of manpower allocation to the administrative officials who put the policies into effect in every locality. . . . In proceeding to take workers, either singly or in groups, from one plant in order to allocate them to another, the government imposes certain restrictions on its own activities in order to protect some of the more critical industries. For example, the Ministry of Labor has placed a "ring fence" around the chemical, iron, and steel industries [and agriculture to a great extent]. That is to say, it normally permits no employees to be taken from these industries for any purpose. Even certain office staff employees are reserved from military conscription and are kept within these industries, although individuals are frequently transferred from one plant to another within the industry.

(*Continued on page 10*)



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(*Continued from page 8*)

As more and more men were being drawn into the armed services, special procedures were worked out for transferring women from less essential work to war work, and for employing unoccupied women. . . . Women between the ages of 31 and 45 may be directed by the Ministry of Labor to industrial employment, unless they have children under 14 years of age, and except in cases where unusual hardship would result. . . . In order to direct women into the most useful war jobs, an order has been issued prohibiting the employment of women between the ages of 18 and 31 except through the official Employment Exchanges. . . .

Economic Stabilization

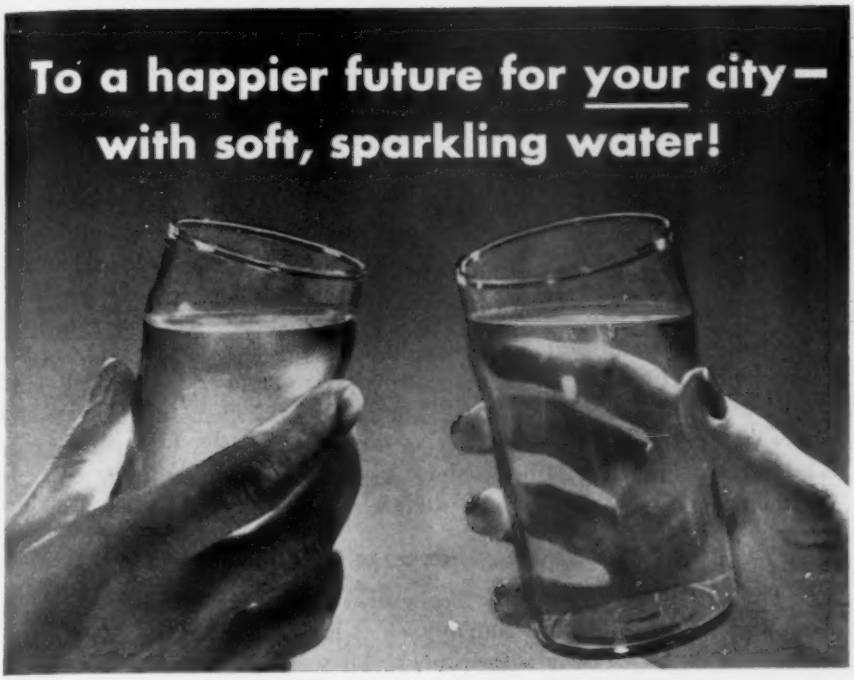
Special programs of subsidy, of economic control, and of welfare are carried on in order to make possible this drastic assignment and virtual conscription of both civilian and military manpower. One aspect of this program is the general economic stabilization which is intended to prevent inflation, and maintain compensation at a fair level. This is complemented by a rationing program to insure that the necessities of life will be available to everyone, and by other measures such as a savings campaign and subsidies for certain types of food. The British government undertook to see that wages were stabilized, but decided that it was no more necessary or desirable to freeze wages than to freeze everyone permanently in his job. . . .

The control of rents and general rationing were accompanied by the development of a program for the manufacture of standardized necessities such as clothing and furniture. These "utility goods" are made according to quality standards established by the government. This measure was found to be an essential underpinning for the rationing program. . . . After all these steps are taken, it still remains necessary to see that the worker can buy the necessities that wartime conditions might make less accessible. Housing, transportation, and public utilities, for example, are essential services that cannot be evenly redistributed as population shifts from one place to another. . . .

Welfare Department Under Ministry of Labor

In order to keep in close touch with the unfulfilled needs of the war worker, the Ministry of Labor found it desirable to establish an "outside" welfare department, which employs regional welfare officers. It is the job of these staffs to keep in touch with local conditions and to discover any deficiencies in the provisions for the welfare outside the factory of the workers, whether in respect to transportation, living accommodations, recreational facilities, or other needs. . . . The Factory Inspectorate of the Ministry is responsible for enforcing the health and safety requirements of the Ministry inside the factory. . . . In order to make decisions balancing the need for direct war industry work against the need for community

(*Continued on page 12*)



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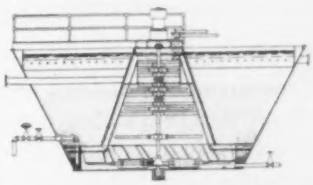
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(*Continued from page 10*)

services (no matter whether carried on by private business or by municipal or other governmental agencies), the manpower agency must adjust its administrative organization and procedures so that from the national capital to its most remote local organization it can clear information and make judgments that will be to the best interests of the social structure and the national strategy. . . . The purpose of the government, according to the Minister of Labor and National Service, is to see that in every factory, personnel management is on a par with the management of operations itself. As a part of the current manpower policy, this emphasis on personnel management is significant. It means that in the British factory, as in the country as a whole, manpower is regarded as an asset to be carefully conserved and judiciously allocated. But it follows, since the Ministry of Labor has taken the responsibility of directing workers to remain in an establishment, that the Ministry must also take the responsibility concerning their working conditions and welfare.

Delegation of Powers to Government

The British people through Parliament have granted to their government powers more sweeping than any which have been exercised by English speaking authorities in modern times. They have done so only because they were confident that the government would use its powers to make action possible after a general agreement on policy had been reached, but that decisions on such policies should not be sprung on the people without warning. It is perfectly clear, under present legislation, that dictatorial operation is prevented in Great Britain not by statutory restrictions—for virtually none exist—but by a much stronger force—a general sense of political responsibility and the cooperation of a free people. . . .

System of Consultations

In planning any action that will call for an extensive readjustment of employment practices or the extensive transfer of workers, the official authorities always clear the matter carefully with the groups affected and enlist their help as much as possible, as in the case of the plans for the concentration of industry, the withdrawal of workers from shops or factories, and the addition of employees to expanding plants. . . .

The process of consultation is important because it signifies to everyone that the government is not making hidebound decisions without taking into consideration their effect on all concerned. Public confidence in this attitude is essential if all groups are to be expected to co-operate wholeheartedly in the prosecution of the war. It is important to distinguish between an extensive system of consultation on manpower policy and the domination of manpower policy by conflicting pressure groups. If all the claimants on manpower were to decide manpower policy by mutual bar-

(*Continued on page 14*)

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SOFT CORROSIVE WATER
HIGH BICARBONATE WATER
LIME-SODA SOFTENED WATER

Calgon treatment *WORKS* —*in any of these waters!*

SCALE prevention and corrosion control *used to be* a merry-go-round of troubles. Solving the scale problem often introduced corrosion —and safety from corrosion could usually be obtained only by forming scale. Now, Calgon *ends* this dilemma — solves four major treatment problems *without causing new ones.*

Soft corrosive water riddles piping and plagues consumers with "red water." Adding alkali to retard corrosion by means of a scale coating usually forms too much scale in lines near the plant and not enough at farther points. Calgon works differently. It maintains a thin, protective film over pipe metal and metal oxides throughout the system and reduces the attack of oxygen so effectively that corrosion ceases to be a serious problem and "red water" is eliminated.

"Red water" also results from precipitation of dissolved iron from well water, upon exposure to air, where the dissolved iron exceeds 0.3 ppm. Iron removal equipment is usually not employed unless dissolved iron exceeds 1 ppm., and even then it is not uncommon for "red water" to continue because of corrosion induced by oxygen dissolved in the water during the iron removal process. The best procedure is to add Calgon to well water as it is pumped. This prevents precipitation of dissolved iron and eliminates "red water" and the need for costly removal equipment.

Lime-soda softened water, after filtration, usually contains exce calcium carbonate in solution. Unless this supersaturation can be effectively controlled, scale will form in water lines and hot-water heaters. Effective stabilization, with complete security from corrosion, can best be obtained with Calgon. Added after the softening process, it stabilizes water throughout the system, and eliminates precipitation of calcium carbonate scale in hot-water heaters.

Hard high-bicarbonate water causes scale in consumers' heating coils, tanks and hot-water lines. Calgon offers a simple, economic means of stabilizing water and eliminating scale from household lines.

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HAGAN BUILDING PITTSBURGH, PA.

(*Continued from page 12*)

gaining processes, the result could be only chaos and frustration for all. On the other hand, a strong and courageous Minister who is alive to the need for balancing all essential requirements may maintain a system of consultation and yet synthesize a program that best serves the national interest.

Thus the British government works out its manpower program with three main relationships fixed firmly in mind—relationships that were ignored in previous wars when the civilian population was not considered almost universally liable for service. First, there is the relationship between the battles to be fought and the munitions to be produced on the one hand and the total available supply of specialized skills on the other. This relationship requires a careful balance of the needs of all the military and civilian war agencies, and a continuous readjustment of that balance in harmony with national strategy.

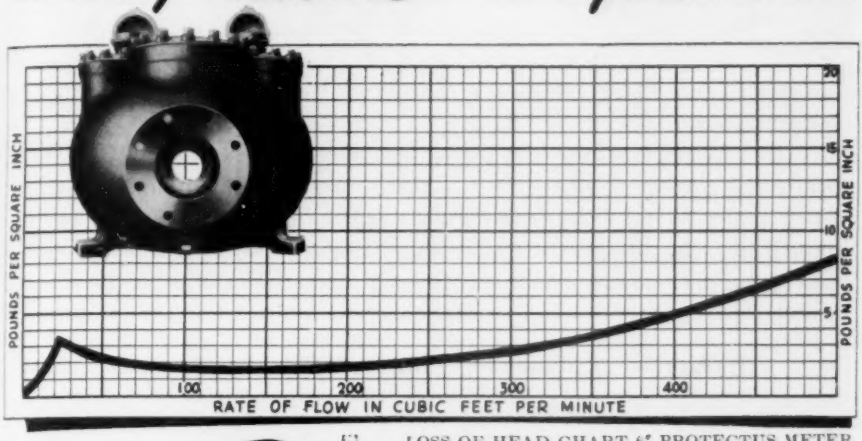
The second relationship is that between the skills that need to be devoted directly to service in war industries or the armed forces and the work necessary to keep those skills functioning at full efficiency. This essential though secondary type of effort ranges all the way from the maintenance of public utilities to the provision of recreation.

(*Continued on page 16*)

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(*Continued from page 14*)

The third relationship is that between the government and its manpower—which the government does not forget is the power of its free citizens. "Manpower" *is* the citizens who are demanding that the government lay down the criteria by which they will be told where to serve, and provide a system to give them a hearing if they think that those criteria are being applied unfairly.

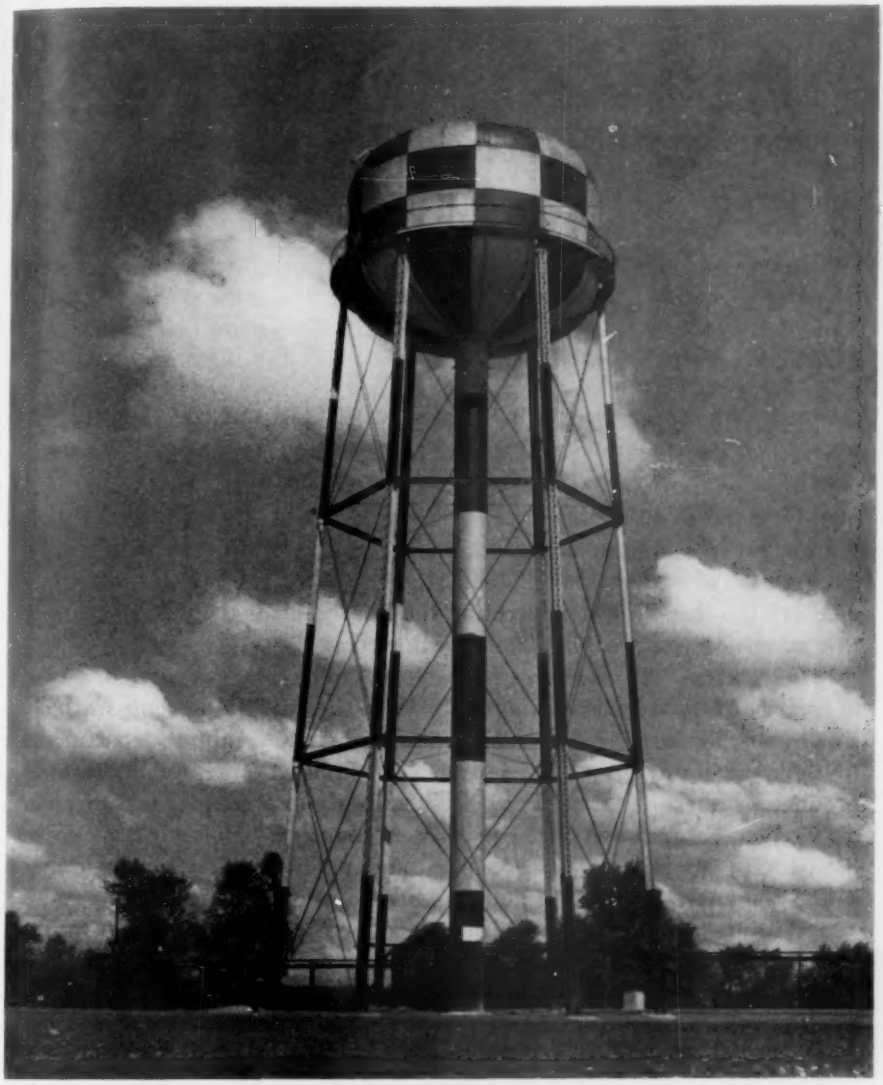
All these relationships cut across nearly all aspects of society. They require the immediate adjustment of policy and the immediate application of new policy to individual cases whenever the fortunes of war demand it. Accordingly, the administrative structure and the procedures of the manpower program constitute an intricate set of interrelationships, [as described below].

Integration of Manpower Phase in Entire War Program

The manpower problem is so thoroughly interlocked with other aspects of national policy that a manpower program can be drafted only through the collaboration of the manpower agency with other principal war agencies. . . . The over-all program, however well designed, means little if it is not supported by a closely knit administrative organization and institutional arrangements designed to make it responsive to the demands of national policy and strategy. Conversely, the best intentioned efforts of the most perfect administrative organization will be defeated unless the manpower program is an integral part of both the military strategy and the economic and productive program.

When the British government was forced by the war to expand and convert its normal functions, it proceeded to adapt most of the existing ministries to their appropriate wartime functions and to create a few new ministries to work in fields which before that time the government had not entered. The administration of each ministry is directed by a single head, the minister, but, in order to provide a flexible system of collaboration, it was deemed necessary to create, in addition to the War Cabinet, a series of inter-ministerial committees to handle by consultation the problems that were the concern of more than one ministry. . . . What types of manpower questions go before the War Cabinet? The final decision on the size of the armed forces, for example, would be made by the War Cabinet. If the ministry concerned primarily with the manufacture of munitions were to decide, it would tend to reserve too many men for war industries and give the army too few, not out of personal spite or dishonesty, but out of a laudable zeal for getting his job done, and because the restricted purpose of its organization would distort the data on which its judgment was based. It would be likely to make biased decisions even though it realized that its protection depended on the army and the munitions it produced would be useless unless placed in the hands of an adequate

(*Continued on page 18*)



Water Tanks in War

The problem of supplying water during this war time evolves itself into two phases. The general public must get along with what they have. Military camps, munitions plants and other war industries must utilize simple, efficient systems such as elevated tanks to provide gravity pressure.

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(Continued from page 16)

number of soldiers. On the other hand, if the army leaders were to decide, their decision would tend to be biased in the opposite direction and for similar reasons. If both tried to decide, they would find themselves competing most wastefully for manpower. The War Cabinet makes the final decision on such major questions as this. . . .

Government Supervision of Production

In order to describe the manpower program, it is first necessary to see how the government's supervision of production is organized. Until the beginning of this war, a department for the procurement of military supplies and equipment was incorporated in each of the three service ministries, the Army, the Navy, and the RAF. . . .

The Ministry of Aircraft Production procures airplanes and accessory equipment for the RAF. The Admiralty Supply Department provides many of the principal items of equipment for the Navy. The Ministry of Supply procures all supplies for the Army. It also supplies many items for the other services, such as uniforms, motor vehicles, and guns and ammunition of various kinds. The Ministry of Supply is a general supply ministry in other respects, operating the iron, steel, tin, rubber, and other raw material "controls" and the machine tool "controls."

In February of this year, a Minister of Production was created, a kind of super-coordinator of production. With the aid of a comparatively small staff, he exercises his influence over the three supply departments by the issue of directives. The Minister of Production represents the war production interests in the Lord President's Committee and is a member of the War Cabinet and of the Defense Committee. He maintains direct liaison with the joint chiefs of staff through a new instrumentality known as the Joint War Production Planning Staff of which he is chairman. . . .

With the early vast increase in production there was a tendency for the production agencies to locate or expand war factories without regard for the labor supply. This was one of the greatest weaknesses in the earlier procedures. . . . If workers are to be brought to any area, the Ministry must work closely with the Ministry of Health, the Ministry of Transport, and local governments in order to make sure that adequate housing, sanitary facilities, and transportation can be made available. This system of interrelationship assures that no major policy is formulated in the British government without careful consideration of its manpower aspects. . . .

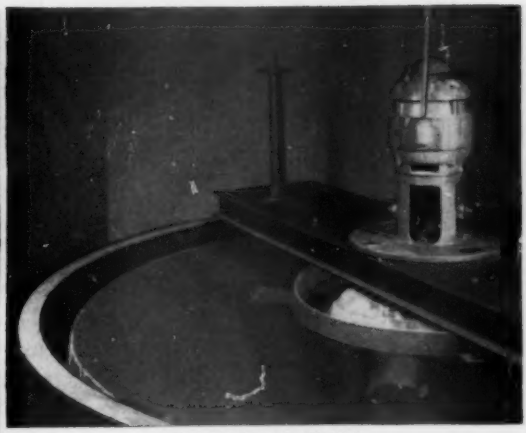
Work of the Manpower Committee

The Manpower Committee and its subcommittees carry on the work of (1) formulating, via the appropriate ministers, new policy for consideration by the Lord President's Committee and the War Cabinet, and (2) continually adjusting the competing demands for specific types of manpower. . . .

(Continued on page 20)

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(*Continued from page 18*)

To make the national interest prevail in the light of constantly changing conditions, a national list of jobs of high urgency is prepared every two weeks and distributed to the field offices. . . .

There are other important devices for co-ordinating the manpower program at the regional level. Thus every employer in an essential industry is required to file a detailed statement of the number of persons employed in his establishment each quarter. The list is broken down into specific groups of skills. He is further required to estimate his manpower requirements for the succeeding quarter by numbers of individuals within categories of skills, and to set forth the proportion of his current output distributed between the three supply ministries, production for export, and home production. The supply ministries receive copies of these estimates and make adjustments as they deem proper. The sum of the requirements give the Regional Board and the Ministry of Labor and the Lord President's Committee a comprehensive figure of anticipated labor requirements for the succeeding quarter by categories of skills. . . . It is the function of the Labor Supply and Training Department of the Manpower Division to see that the necessary policies, programs, and procedures are formulated that will result in a supply of manpower for civilian purposes. The Military Recruitment Department has the corresponding responsibility for the manpower supply of the armed forces. A third unit, the National Service Department, stands between the Labor Supply and Training Department and the Military Recruitment Department with the object of keeping the supply for civilian and military needs in balance, subject to the high policy directives. . . .

General Decentralization and Special Cases

By and large, the Ministry of Labor has decentralized the various aspects of its manpower program, but as a matter of policy it decided that there are several groups of skills that should be considered from the national point of view in the matter of military deferment. Skills allocated by means of the national register provide an example, but this policy is put into effect in still another important instance. The national headquarters of the Ministry administers a system of deferment from military service that applies to a wide variety of specialized occupations in which the decision on the deferment application is made at the national headquarters. In these "Special Arrangements Schemes" a committee representing the occupation or profession, usually presided over by an impartial chairman, advises the Ministry whether particular members of that occupation should be deferred from military service. . . .

These so-called Special Arrangements Schemes for deferment are based on the view that it is essential to maintain in civilian employment an adequate supply of certain skills that can best be appraised from a national

(*Continued on page 22*)



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(*Continued from page 20*)

point of view. No district or regional office, for example, can possibly decide whether a particular administrative or executive official should be retained in the service of the national government or permitted to go into the military service. Only a judicious, impartial, and distinguished national committee can review such cases. . . .

Functions of the Employment Exchanges

Registration for military service takes place at the Exchange, as do also the registrations for industrial employment. As the control of hiring has been assumed by the Ministry of Labor, the tendency is to have all placements in essential employment made through the local Employment Exchange. When workers are directed to industrial employment, it is the National Service Officer (usually a deputy manager or other officer of the Employment Exchange) who directs the individual to the particular place of essential employment. Likewise, it is the National Service Officer at the Exchange who decides in the first instance whether an employer covered by the Essential Work Order may dismiss a worker, or whether the worker may leave the employer. The decision is made subject to standards and

(*Continued on page 33*)

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Changes in Membership

NEW MEMBERS

Applications Received October 1 to 31, 1942

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Bibeau, Joseph A., Supt., Public Works & Water Works, City Hall, St. Boniface, Man., Can. (Oct. '42)

Boes, Robert J., Public Health Engr., Dept. of Health, City Hall, Winona, Minn. (Jr. M. Oct. '42)

Boezinger, H., Pacific Coast Dist. Mgr., Pittsburgh Equitable Meter Co., 3136 E. 11th St., Los Angeles, Calif. (Oct. '42)

Bradshaw, Arthur W., Asst. Analyst, North Jersey Dist. Water Supply Com., Burnside Pl., Haskell, N.J. (Oct. '42)

Brooks, C. B., *see* Hemp Water Dept.

Brown, Samuel, Asst. Civ. Engr., Bureau of Water Supply, 6301 Bellona Ave., Baltimore, Md. (Oct. '42)

Burdick, George E., *see* New York State Conservation Dept.

Catanese, Santi J., Asst. Engr., Bureau of Water Supply, 2030 Penrose Ave., Baltimore, Md. (Oct. '42)

Christie, H. B., Asst. Engr., Wm. M. Piatt & Lee Engineering Corp., 906 N. Gregson St., Durham, N.C. (Oct. '42)

Clewiston, City of, E. E. Gross, Engr., Electric & Water Works System, Clewiston, Fla. (Corp. M. Oct. '42)

Connors, Joseph J., Bacteriologist-Chemist, East Bay Munic. Utility Dist., 2138 Center St., Berkeley, Calif. (Oct. '42)

Cramerton Mills, Inc., C. O. Young, Supt., Cramerton, N.C. (Corp. M. Oct. '42)

Crow, W. H., *see* Monroe, City of

Dement, Edward F., Chief Plumbing Foreman, Post Engineers, Camp Butner, 1201 Mangum St., Durham, N.C. (Oct. '42)

Dierker, Fred H., Jr. Engr., East Bay Munic. Utility Dist., 512—16th St., Oakland, Calif. (Oct. '42)

Dunn, Town of, Robert E. Wooten, Supt. of Water Works, Dunn, N.C. (Corp. M. Oct. '42)

Durbrow, William, *see* Nevada Irrigation Dist.

Ellis, Roy O., Supt., Oskaloosa Munic. Water Plant, Oskaloosa, Iowa (Oct. '42)

Forest City Water Works, B. B. Green, Supt., Forest City, N.C. (Corp. M. Oct. '42)

Forni, George P., 1379—62nd St., Emeryville, Calif. (Assoc. M. Oct. '42)

Gastonia, City of, Robert Van Sleen, Supt. of Utilities, City Hall, Gastonia, N.C. (Corp. M. Oct. '42)

Glasgow, George, Water Chemist, 331 Lowe St., South Williamsport, Pa. (Oct. '42)

Green, B. B., *see* Forest City Water Works

Gregory, T. H., Supt., South Montebello Irrigation Dist., 864 W. Washington St., Montebello, Calif. (Oct. '42)

Gross, E. E., *see* Clewiston, City of

Harwood, S. A., Consumers Dept., Conservative Water Co., 8627 Fir St., Los Angeles, Calif. (Oct. '42)

Helms, Perry H., Supt., Water Dept., Box 534, Myrtle Beach, S.C. (Oct. '42)

Hemp Water Dept., C. B. Brooks, Supt., Hemp, N.C. (Corp. M. Oct. '42)

Hillsboro Water Dept., M. P. Lloyd, Supt., Box 386, Hillsboro, N.C. (Corp. M. Oct. '42)

Holman, Albert L., Chemist, Water Works, Covington, Ky. (Oct. '42)

Kauffman, Winfield S., Asst. Civ. Engr., Bureau of Water Supply, 774 Linnard St., Baltimore, Md. (Oct. '42)

Kilcawley, E. J., Prof. of San. Eng., Rensselaer Polytechnic Inst., Troy, N.Y. (Oct. '42)

Kochendorfer, John S., Chemist, Dept. of Water, 1041 Wyoming St., Dayton, Ohio (Oct. '42)

Kure Beach Water Works, L. C. Kure, Supt.-Owner, Kure Beach, N.C. (Corp. M. Oct. '42)

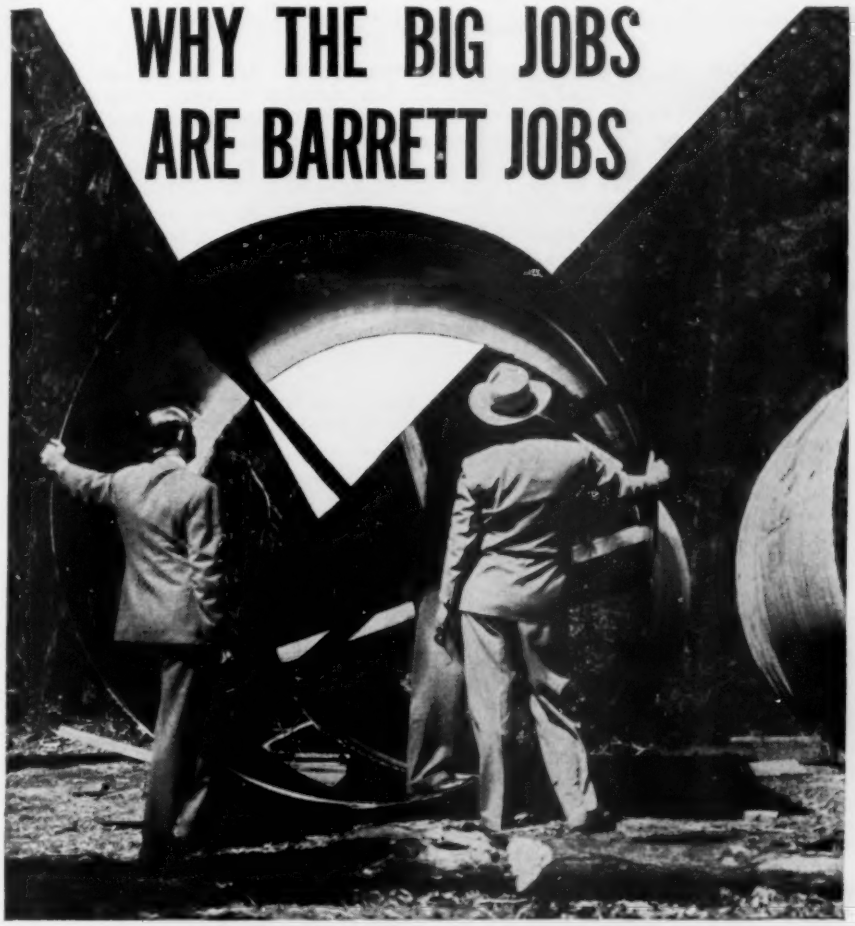
Kure, L. C., *see* Kure Beach Water Works

Lamley, George E., Asst. Civ. Engr., Bureau of Water Supply, 3136 Northway Drive, Baltimore, Md. (Oct. '42)

Lancaster, Ben E., Supt. of Water Works, Roanoke Rapids Sanitary Dist., Municipal Bldg., Roanoke Rapids, N.C. (Oct. '42)

(Continued on page 28)

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(*Continued from page 26*)

Lang, William H., Chemist, Newport News Water Works Com., R.D. No. 1, Denbigh, Va. (Oct. '42)

Lenoir Water Dept., M. M. Williams, Supt., Lenoir, N.C. (Corp. M. Oct. '42)

Lloyd, M. P., *see* Hillsboro Water Dept.

Lux, Kathleen F. (Miss), Asst. San. Engr., State Board of Health, 1915 E. Riverside Drive, Indianapolis, Ind. (Jr. M. Oct. '42)

McMinn, H. E., Supt., Water Dept., City Hall, Carlsbad, N.M. (Oct. '42)

Mercer, Keith, Mgr., Paterson Engineering Co. of Canada, Ltd., 1100 Craig St., E., Montreal, Que., Can. (Oct. '42)

Miller, John B., Assoc. Engr. & Acting Director, Bureau of San. Eng., State Board of Health, Box 210, Jacksonville, Fla. (July '42)

Milne, Frank, Repr., Hersey Mfg. Co., 310 Seneca Parkway, Rochester, N.Y. (Oct. '42)

Monroe, City of, W. H. Crow, Supt. of Water & Light, Monroe, N.C. (Corp. M. Oct. '42)

Nevada Irrigation Dist., William Durbrow, Mgr., 144 S. Auburn St., Grass Valley, Calif. (Corp. M. Oct. '42)

New York State Conservation Dept., George E. Burdick, Jr. Aquatic Biologist, 21 S. Fitzhugh St., Rochester, N.Y. (Oct. '42)

North Carolina, Univ. of, H. E. Thompson, Supt. of Utilities, Box 391, Chapel Hill, N.C. (Corp. M. Oct. '42)

Pegg, Edwin S., Supt., Cherry Valley Water Dept., Cherry Valley, N.Y. (Oct. '42)

Peloso, George D., Repr., Pittsburgh Equitable Meter Co., 2435 Devoe Terrace, New York, N.Y. (Oct. '42)

Philhower, Sara K. (Miss), Chemist, Water & Light Dept., 410 S. Chester St., Gastonia, N.C. (Oct. '42)

Pinehurst, Inc., John F. Taylor, Supt. of Utilities, Pinehurst, N.C. (Corp. M. Oct. '42)

Pope, B. L., Supt. of Public Works, Newton, N.C. (Oct. '42)

Pritchard, E. E., Chemist, State Board of Health, 1098 W. Michigan St., Indianapolis, Ind. (Jr. M. Oct. '42)

Randleman, City of, G. P. Upton, Supt. of Water Works, Randleman, N.C. (Corp. M. Oct. '42)

St. John, C. H., Instrument Maker, U.S. Naval Air Station, Power Plant, Box 1411, Pensacola, Fla. (Oct. '42)

Schuhmacher, G. S., Service Engr., Los Angeles Branch, Calgon, Inc., 1807 E. Olympic Blvd., Los Angeles, Calif. (Oct. '42)

Setzer, H. K., Supt. of Public Works, Hickory, N.C. (Oct. '42)

Shaw, W. E., Regional Water Works Advisor, Bureau of San. Eng., State Dept. of Public Health, 6510 Pineneedle Drive, Oakland, Calif. (Oct. '42)

Taylor, John F., *see* Pinehurst, Inc.

Thompson, H. E., *see* North Carolina, Univ. of

Upton, G. P., *see* Randleman, City of

Van Sleen, Robert, *see* Gastonia, City of

Von Scheidt, J., Asst. Secy., Hackensack Water Co., 4100 Park Ave., Weehawken, N.J. (Oct. '42)

Williams, M. M., *see* Lenoir Water Dept.

Wood, Frank B., 1610 Chambers St., Vicksburg, Miss. (Oct. '42)

Wooten, Robert E., *see* Dunn, Town of

Wright, Robert D., Asst. Engr. & Cashier, City Water Dept., Lynchburg, Va. (Oct. '42)

Young, C. O., *see* Cramerton Mills, Inc.

Zadigan, Ruben, Divisional Water Officer, 25th Armored Engineer Batallion, A.P.O. 256, Desert Maneuvers, c/o Postmaster, Los Angeles, Calif. (Oct. '42) ★

REINSTATEMENTS

Campbell, M. S. A., Bacteriologist, State Board of Health, 1098 W. Michigan St., Indianapolis, Ind. (July '35)

Dappert, Anselmo F., Prin. San. Engr., State Dept. of Health, Albany, N.Y. (Apr. '31)

Warren, Chester A., Assoc. Engr., Bureau of Water Supply, 1633 N. Caroline St., Baltimore, Md. (May '22)

LOSSES—DEATHS

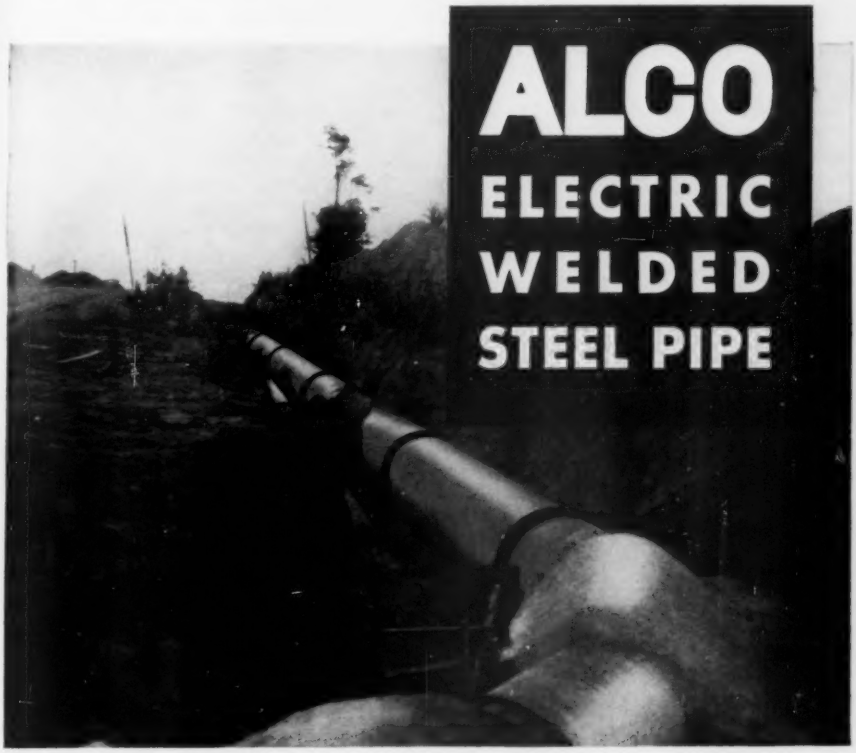
Lippincott, J. B., Cons. Engr., 714 W. Olympic Blvd., Los Angeles, Calif. (Jan. '36)

Morales, Luis, Cons. Engr., Morales & Co., Compostela 158, Havana, Cuba (Jan. '39) *Director '41.*

Morgan, Mel, Water Supt., Water Dept., Enumclaw, Wash. (Apr. '39)

Quigley, Lewis A., Supt., City Water Works, 3320 W. Berry, Fort Worth, Tex. (June '27)

Swittenberg, R. L., Supt., Duke Power Co., Anderson, S.C. (Apr. '39)



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Changes in Address

Changes of address between October 15 and November 15, 1942

Allen, John Bolling, 2651—16th St., N.W., Washington, D.C. (Jan. '42)

Allis-Chalmers Mfg. Co., H. P. Binder, Mgr., Centrifugal Pump Dept., Milwaukee, Wis. (Assoc. M. June '05)

Banks, Harvey O., 1628 N. Roosevelt Ave., Pasadena, Calif. (Jan. '41)

Bevington, F. E., Inspector of Water & Sewer Installations, Federal Housing Authority, 725—32nd St., Milwaukee, Ore. (Affil. Jan. '42)

Binder, H. P., *see* Allis-Chalmers Mfg. Co.

Carl, Kenneth J., Engr., National Board of Fire Underwriters, 5721—11th St., N., Arlington, Va. (Oct. '41)

Chanlett, Emil T., 816 Oregon Bldg., Portland, Ore. (Apr. '42)

Childs, Fred S., 88 Union Ave., Clifton, N.J. (May '30)

Corbalis, James J., Jr., San. Engr., Fairfax County, Fairfax, Va. (Apr. '42)

Dillon, S. E., Secy.-Mgr., Bakersfield, Munic. Water Dist., 1524—18th St., Bakersfield, Calif. (May '27)

du Bruyne, Robert M., 824 Circle Drive, High Point, N.C. (Oct. '41)

Fergus Falls Water & Light Dept., Joseph E. Young, Supt.-Engr., Fergus Falls, Minn. (Corp. M. July '38)

Golden, A. T., Water Treatment Plant Operator, Los Angeles Dept. of Water & Power, 16931 Sherman Way, Van Nuys, Calif. (Apr. '33)

Hagar, Major C., 37 Barnum Pl., Wilkes-Barre, Pa. (Apr. '39)

Harvill, Clyde R., 1659 Vassar St., Houston, Tex. (Apr. '41)

Hays, W. J., Engr., 1314 Monterey Ave., Berkeley, Calif. (Oct. '39)

Heffelman, M. C., *see* New Mexico Power Co.

Herron, William L., Box 234, Oswego, N.Y. (Oct. '37)

Horton, Robert K., Div. of Health & Sanitation, Office of Co-ordinator of Inter-American Affairs, 3624 Dept. of Commerce Bldg., Washington, D.C. (Jr. M. Oct. '40)

Idaho, Univ. of, W. W. Tinniswood, Civ. Eng. Dept., Moscow, Idaho (Corp. M. Jan. '35)

Jorgensen, Homer W., c/o U.S. Engr. Office, 4133 Main St., Riverside, Calif. (Oct. '39)

Kallis, Selma G. (Mrs.), 5913 Fourth St., N.W., Washington, D.C. (May '33)

Kerr, S. Logan, Hydr. Engr., 31 W. Allens Lane, Philadelphia, Pa. (Jan. '35)

Kroschwitz, Fred, Salesman, Mueller Co., 563 Cleardale Ave., Trenton, N.J. (July '40)

Lyle, Newton B., 1748 Capouse Ave., Scranton, Pa. (June '26)

MacPherson, Roderick, 4800 Kimbark Ave., Chicago, Ill. (Jan. '41)

McGuire, Orla E., Bureau of Eng., State Dept. of Health, Lansing, Mich. (Jan. '39)

Meyer, Herman, 3061 S.W. 21st St., Miami, Fla. (July '42)

New Mexico Power Co., M. C. Heffelman, Vice-Pres. & Gen. Mgr., Santa Fe, N.M. (Corp. M. Mar. '24)

Parks, W. J., Jr., San. Engr., Post Engr.'s Office, 65 N.E. 71st St., Miami, Fla. (Aug. '29)

Paulson, Everett J. I., Chemist Operator, Fridley Softening Plant, 43rd & Marshall St., N.E., Minneapolis, Minn. (Jan. '41)

Pearce, Fletcher W., 3—10th St., Havre, Mont. (Jan. '42)

Perez Guerra, Gustavo, Apdo. 168, Caracas, Venezuela (Apr. '40)

Potter, Howard H., San. Engr., U.S. Public Health Service, Office of Civilian Defense, 17 Court St., Boston, Mass. (Jan. '40)

Schoeninger, Carl J., Engr. of Sewage Treatment, Sewage Treatment Plant, 9300 W. Jefferson Ave., Detroit, Mich. (Oct. '39)

Spence, W. O., Chief Operating Engr., Fort Bragg Water Plant, Sanford, N.C. (Apr. '30)

Tinniswood, W. W., *see* Idaho, Univ. of

Todd, J. S., 712 Luckystone St., Kirkwood, St. Louis, Mo. (Apr. '41)

Wolbert, H. E., 669 N. Terrace Ave., Mount Vernon, N.Y. (May '16)

Wolfe, Edward E., 6284 Cates Ave., University, Mo. (Apr. '22)

Young, Joseph E., *see* Fergus Falls Water & Light Dept.

(*Continued on page 32*)

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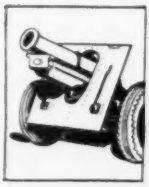
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(*Continued from page 30*)

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Allen, John Bolling, 2651—16th St., N.W., Washington, D.C. (Jan. '42)★

Brown, John L., Jr., Supt., Cannon Mills Co., Box 242, Concord, N.C. (Jan. '39)★

Bryan, W. D., Jr., Mgr., Water Plant, Tarboro, N.C. (July '40)★

Burnham, Lyle M., Supt., Water Works, Civic Center, Bartlesville, Okla. (Oct. '40)★

Dickson, W. K., Civ. Engr., 119 Circle Ave., Charlotte, N.C. (Apr. '38)★

du Bruyne, Robert M., 824 Circle Drive, High Point, N.C. (Oct. '41)★

Earp, Fred B., Draftsman, City Water Dept., Durham, N.C. (Jan. '41)★

Gotaas, Harold B., Chief, Eng. Sec., Office of Co-ordinator of Inter-American Affairs, Dept. of Commerce Bldg., Washington, D.C. (Jan. '38)★

Grady, Robert H., 1305 Colonial Rd., Raleigh, N.C. (Jan. '40)★

Harris, H. H., Engr. & Water Supt., Palisades Del Ray Water Co., 427 Moscow St., Venice, Calif. (Oct. '38)★

Holaday, K. M., Chem. Engr., Anheuser-Busch, Inc., 721 Pestallozzi St., St. Louis, Mo. (Jan. '40)★

Horton, Robert K., Div. of Health & Sanitation, Office of Co-ordinator of Inter-American Affairs, 3624 Dept. of Commerce Bldg., Washington, D.C. (Jr. M. Oct. '40)★

Ihling, Herbert M., Field Engr., Water Dept., City Engr.'s Office, City Hall, Milwaukee, Wis. (Jan. '40)★

Moggio, William A., 1004 Carolina Ave., Durham, N.C. (Jan. '40)★

Stillwell, Howard L., 325 Second Ave., S.E., Atlanta, Ga. (Jan. '39)★

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(Continued from page 22)

regulations of the Ministry, and subject to appeal by employer and worker.

It is the local Employment Exchange that pays the worker his travel allowance when he is transferred to essential work in other communities, his weekly lodging allowance when he leaves responsibilities behind him upon transfer, and whatever other forms of allowance are provided for transferred war workers by the national government. It is through the Local Employment Exchange that employers file the basic employment statistical forms (the "L" forms), giving estimates of their anticipated labor requirements for the succeeding quarters.

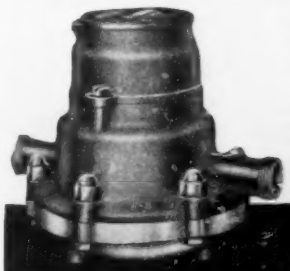
When someone wishes to appeal from the call to military service on the grounds of personal hardship, he will file his appeal at the local Employment Exchange. Similarly, he goes to the Exchange when he wishes to appeal from a "direction" by the National Service Officer to proceed to some other essential employment or to remain in his present employment. Also, when an employer wishes to appeal against an action by the National Service Officer (e.g., an action directing the employer not to discharge a worker or permitting the worker to leave his employment against the employer's wishes), he goes to the local Employment Exchange.

Inspectors' Assistance in Saving Manpower

The Labor Supply Inspectors try to economize the use of manpower, especially the use of critical skills, even by munitions or aircraft factories. They have ample occasion to investigate the work situation in any plant. A munitions factory for example may ask the Employment agency for a certain number of skilled mechanics. The Labor Supply Inspector will go from the Employment Exchange into the factory, with which he is probably already familiar, to see whether by upgrading, by training, or by reorganization, the factory cannot get along without the men requested. Since requests are continually being made to replace men who have gone into armed service, the Labor Ministry may, by these means, continuously reduce the proportion of skilled labor used. . . . If the Inspector discovers

(Continued on page 35)

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(Continued from page 33)

needed men who can be spared by a war industry, he goes about the job of "extraction," or arranging with the plant for their release. Before resorting to compulsion in any such case, the Labor Supply Inspector and the National Service Officer will have discussed the matter thoroughly with the supply ministry concerned; if the supply ministry does not object to the extraction of workers, the transfer is likely to be made. . . . The Ministry of Labor and National Service does not look on the manpower supply as a constant. It is continually seeking to increase the supply of available skills by its training programs and by encouraging the "upgrading" of workers. More important, it has called upon an increasing number of women within the compulsory service ages to take war production jobs, and it has asked for part-time volunteers even from women with children and with household responsibilities. The Ministry has persuaded factories to accept considerable numbers of part-time workers and, in spite of a considerable turnover in employment among these workers, it considers the effort successful.

In the regional offices the Ministry of Labor has special units for the placement of men who may temporarily be released from the armed services, for the employment of aliens, and for the enlistment of workers

(Continued on page 36)



(Continued from page 35)

from Eire to supplement the labor supply in Britain. Great Britain has tried to weld itself into a single unit with the single purpose of winning the war. Within this unit the Ministry of Labor and National Service has tried to adapt itself to the role of a personnel department. And, like any good personnel department, it has kept closely in touch with every level of the organization it serves, and has set up special branches to deal with problems that should not be forced into a uniform pattern. . . .

Summary of Chief Features of the Program

The following outline of some of the features that account for the strength and unity of the manpower program will be useful.

1. The assignment of the individual to the job that will use his full capacity, whether in the armed forces, in war production, or in essential civilian services, is placed ahead of all other consideration. Moreover, family status is not a primary consideration in deciding whether or not a man shall be deferred from military service.

2. A coherent program exists for deciding how and when an individual can serve the nation best. The Ministry of Labor and National Service is responsible for the administration of all phases of that program. . . .

(Continued on page 38)

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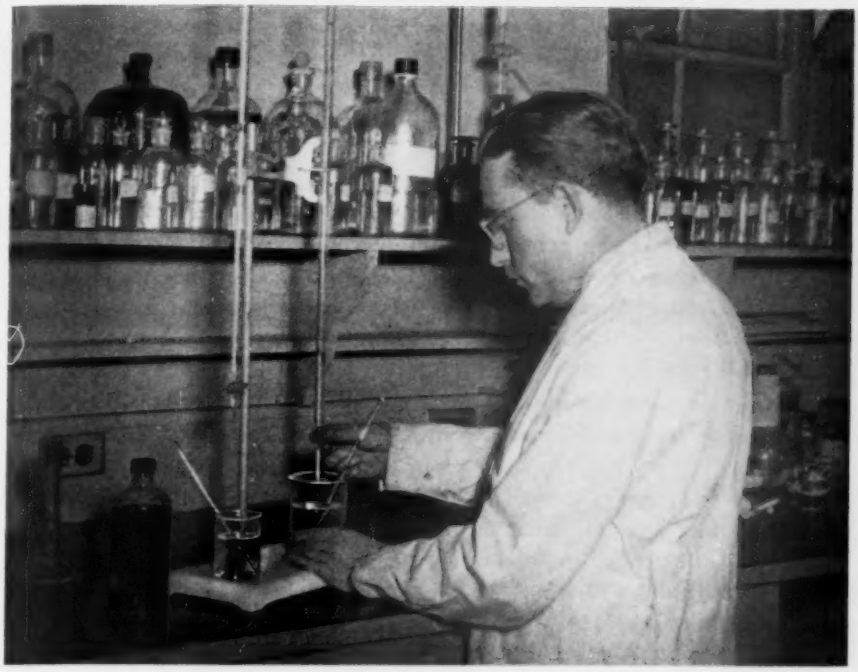
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(Continued from page 36)

The British have escaped in this war the worst difficulties caused by the voluntary enlistment in the armed forces of men with special skills badly needed for war production in industry, agriculture, or other essential civilian services.

1. It was first necessary to define and catalog as precisely as possible all types of essential occupations and to classify all industries. The result of this process was the Schedule of Reserved Occupations.

2. Next it was necessary to keep under continuous review the changing needs of the armed forces and essential civilian employment for each type of skill as a basis for rationing manpower.

3. The administration of the manpower program was lodged in one integrated operating agency, the Ministry of Labor and National Service, which became responsible for the adjustment of deferment policies and procedures. . . . The British experience proved the urgent necessity of planning production programs so as to secure the full utilization of local labor supply and to minimize the transfer of labor. It was necessary to require that the production planning agencies utilize existing plant facilities wherever possible, with due regard to the available local labor supply. It was demonstrated that the concentration of less essential industries should be so planned as to utilize the workers released from such industries and so minimize labor transfer.

Experience showed that it was necessary for the manpower agencies to develop the closest possible relationship with the production agencies on the one side and the housing and welfare agencies on the other.

In short, the British experience shows that the best way to deal with the transfer of labor is to avoid it wherever possible. . . .

The British government experienced the wastefulness of providing housing, community services, transport, and welfare programs for transferred workers; better planning might have expanded war production where labor supply was available. Ultimately, the British found it advisable to

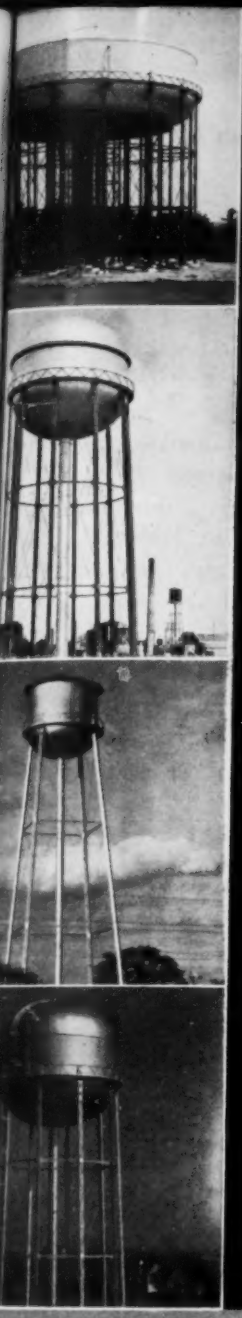
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(*Continued from page 38*)

improvise procedures to make sure that manpower and all problems related to it would be considered in the planning of production. . . .

When it is planned to concentrate less essential industries, it is necessary to take the labor supply factor into account, so that the workers released by the closing of factories may be directed to essential industries with the minimum of labor transfer. . . . The British manpower program could not have been successful if the manpower organization had not been closely geared to national economic policy and the war strategy.

1. It was essential that a single operating agency be charged with the administration of all phases of the manpower program. The Ministry of Labor was put in a position where it could, if necessary, within the framework of high policy, over-rule any particular demand for manpower, and bring all manpower demands into balance.

2. The Ministry of Labor was made responsible for collecting the facts about manpower, and formulating the manpower program. Because of the urgent pressures on them, each claimant for manpower is apt to overemphasize his own departmental case. Everyone recognizes that an agency with an over-all view is needed to ration or allocate critical materials among

(*Continued on page 42*)

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(*Continued from page 40*)

the competing demands; the necessity is even greater that an impartial and comprehensive view shall prevail in rationing manpower.

3. In the formulation of the highest national policy, the Minister of Labor has been in a position to see that the manpower aspects of every problem are fully considered. His membership in the War Cabinet and the Lord President's Committee and the Production Committee enables him to participate in the principal decisions of the government affecting manpower. . . .

The War Cabinet brings together the chief political, military, and economic leaders and makes way for the formulation of an increasingly positive program of which the manpower aspects are an integral and important part.

The Public Utilities Commission at London, Ontario has just concluded an interesting agreement with the city council, whereby $50,000 a year will be set aside by the commission and invested in Victory Loan Bonds for use as water works improvements in the post-war period. The commission might have used the surplus for a rebate on water bills or they might have turned it over to the city council for reduction in municipal

(*Continued on page 44*)

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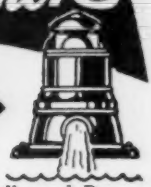
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(Continued from page 42)

taxes. This is a splendid example of planning for the future, when there will be need of projects of this kind. E. V. Buchanan, Past Chairman of the Canadian Section, is General Manager of the Utilities Commission.

O. E. McGuire, who has been Designing Engineer of the Sanitary Division of the Green River Ordnance Plant, Dixon, Ill., has returned to the Bureau of Engineering, Michigan Dept. of Health, Lansing, where he served for 13 years before his recent designing engineering work at Cherry Point, N.C., and Dixon, Ill.

W. O. Spence, formerly Superintendent of Filtration at Sanford, N.C., is now Chief Operating Engineer, Fort Bragg Water Plant, Fort Bragg, N.C.

W. J. Parks Jr., formerly Associate Water Works Engineer, Camp Utility Office, Camp Davis, N.C., is now Sanitary Engineer, Post Engineer's Office, Miami, Fla.

(Continued on page 46)

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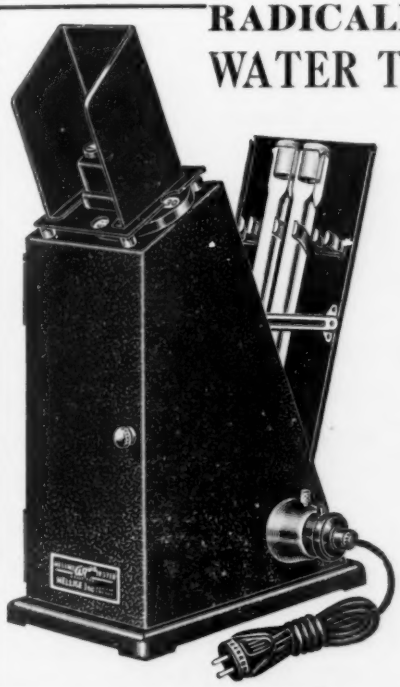


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Engineer to Help You

(Continued from page 44)

James J. Corbalis Jr. resigned from the position of Sanitation Officer with the Virginia State Health Dept. on November 15 to accept a position with the County of Fairfax, Va., as Sanitary Engineer for the organization and administration of two sanitary districts within which water and sewerage works are now being provided by the Federal Works Agency. These districts constitute the metropolitan area of Fairfax County adjoining Arlington and the District of Columbia.

Clyde R. Harvill, formerly Sanitary Engineer for the Houston, Tex., Water Dept., is now on duty as Captain in the Sanitary Corps, Medical Replacement Training Center, Camp Joseph J. Robinson, Ark. Before joining the Houston Water Dept., he was in the U.S. Public Health Service for three years and also served in the Virginia and Alabama State Health Depts.

Rollo K. Blanchard, Vice-President and Engineer of the Neptune Meter Co., and Rolland J. Hamilton, Director of the American Radiator &

(Continued on page 48)

J. B. Lippincott, Consulting Engineer, Los Angeles, died there suddenly on November 4. He was a leading consultant on water and irrigation projects and had practiced in Alaska, Mexico and the Hawaiian Islands as well as western United States. He was born 78 years ago, had been graduated in 1886 from the University of Kansas, and began engineering for the Atchinson, Topeka & Santa Fe Ry. He served many years with the U.S. Geological Survey as hydrographer and in 1902–06 he was Supervising Engineer for the U.S. Reclamation Service. From 1906 to 1913 he was Assistant Chief Engineer of the Los Angeles Aqueduct and then established a consulting practice. He was an Active Member of the A.W.W.A. and an Honorary Member of the A.S.C.E.



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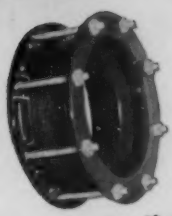
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Style 85

A single-gasketed, self-contained mechanical joint for cast-iron pipe. Designed for strength, flexibility, and resistance to corrosion. Easy to install. Sizes: 4", 6", 8", 10", 12", and 16".



Dresser NO-THREAD Fittings
Style 65

Convenient, self-contained pipe joint. Makes a tight, flexible connection on plain-end pipe. No pipe threading needed. In standard sizes, ⅜" to 2" I.D., including couplings, ells, and tees.



Dresser ADJUSTABLE Repair Sleeve
Style 82

Fixes breaks, holes, and splits in straight runs of cast-iron pipe—quickly, easily, and permanently—without shut-downs. Adjustable to fit varying pipe diameters. Low in cost.



Dresser Bell-Joint Clamp
Style 60

Repairs and prevents leaks in bell joints. Readily adjusted to variations in bell and spigot diameters. Most parts made of high-tensile malleable iron. Easily installed.

DRESSER MANUFACTURING CO. · BRADFORD, PA.

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